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Home Freezing of Seafoods

Indonesian Shrimp Fishery

Red Snapper Fishing

Long-Finned Squid

Solubilized Fish Muscle

Red Crabs in Norfolk Canyon

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MFR PAPER 1026

Proper handling and freezing is the key to home seafood preservation.

Home Freezing of Seafoods

MELVIN E. WATERS

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INTRODUCTION

Freezing, one of the oldest food preservation methods known to man, has long been by far the choice to capture those "just like fresh" characteristics which are so desirable. Drying and salting has its limitations and do not wholly satisfy man's expectations for a preserved product.

Historically, in parts of the world where cold weather made it possible, people have frozen fish on a small scale for later use simply by allowing it to freeze in the cold weather. In those early days, man did not know why freezing prevented spoilage; all he knew was that it did, and that the food tasted pretty good even after months of frozen storage. As he could not depend on the season of the year to preserve his catch year-round, he continued to search for improvements in freezing methods.

Fish were frozen on a commercial scale for the first time in the United States about 1865, primarily to preserve it during transportation. The development of efficient methods for commercially preserving foods by freezing represented a major step forward in the long-time efforts of mankind to discover better ways to preserve foods.

The fish freezing industry has progressed from the covered-pans-with-ice-and-salt method to the complex ammonia and freon refrigeration systems of today. At the end of the 19th century, freezing of fish was an important though rather small industry in New England. New England has had an important history in the development of frozen food methods. Fish made a good low-cost material for the early experiments and was one of the earliest items frozen commercially.

Clarence Birdseye was the pioneer in this regard, conducting a considerable amount of research in Gloucester and Boston. He later organized a company[1] for the commercial production of frozen foods and introduced the consumer-sized container about 1929. Frozen foods can be bought today bearing the name of this man who had an idea and worked hard to bring it to fruition. Springfield, Mass., was the test city for the introduction of frozen fruits and vegetables and much valuable information was obtained there which was put to good use later. This was the start of frozen foods as we know them for consumers.

Birdseye sold his patent and equipment to one of the largest food concerns in the United States. That company began the intensive work of developing additional freezing equipment, working out ways to control enzymes and bacteria, developing cabinets for commercial storage and home use, and all the other things that were necessary before the present day version of the frozen food industry could develop.

Until about 1960 little progress was made relative to the development of more and better food freezing methods. About that time some of the older methods were improved upon (such as brine freezing, which is used extensively in the tuna industry on the west coast). Immersion freezing utilizing propylene glycol or a sugar/salt solution was developed and is being used on a limited scale in the industry today.

The most significant advancements in freezing technology have been made within the past six years. The development of liquid nitrogen, carbon dioxide, and freon freezing systems (Figure 1) have allowed the processor to freeze foods efficiently, economically, and produce a better quality product. These new methods are rapidly sweeping the country, and, in a few years, the old mechanical method of producing refrigeration will be obsolete. It would not be too far out to predict that even these methods will be obsolete in from 10 to 15 years. Technology has made tremendous strides in every field of endeavor since the beginning of the space age.

[1] Use of trade names in this publication does not imply endorsement of commercial products by the National Marine Fisheries Service, NOAA.

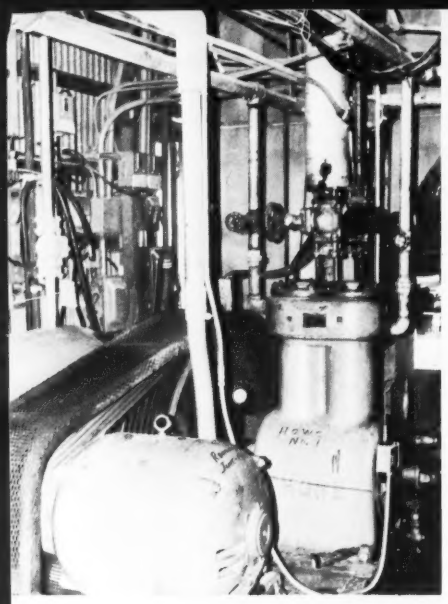


Figure 1.—A new modern industrial liquid freon freezing system.

The term "refrigeration" is hard to define yet is so easy to understand. In simple terms, "refrigeration is produced by the removal of heat." In a more classical definition, "refrigeration is the production and maintenance of the temperature of a substance or space at a lower value than the surrounding atmosphere by the withdrawal of heat." The freezing point of foods is that temperature at which the liquid phase is in equilibrium with the solids. The freezing point of foods is lower than that of pure water and is generally between 32° and 25°F.

SELECTION OF SEAFOOD FOR THE HOME FREEZER

Seafoods are delicious, taste tempting, and provide a delightful addition to any family meal. They also provide excellent nutrition and help stretch the family food dollar. Home freezing is an excellent method for preserving seafoods and will be an added economy since fresh seafoods may be purchased in season when prices are generally lower.

Because some fresh seafoods are seasonal, it is important to learn the availability of seafoods during certain times of the year. The local fish dealer can provide this information and indicate which varieties are the most economical. Fresh fish may be purchased by the pound in any of the following forms: whole, drawn, dressed and drawn, steaks, fillets, and chunks.

The selection of seafoods to put in a freezer is one of the most important phases of freezing food for the family. When purchasing seafoods for home freezing, be sure that they have not been previously frozen. Consult the fish dealer to be absolutely certain. When transporting seafoods to the home, they must be kept as cold as possible. A few hours at room temperature or in the trunk of a car on a warm day can completely spoil many types of seafood.

When buying fresh fish, look for the following characteristics:

1. The flesh of whole fish should be firm and not separating from the bones.
2. If the head is attached, the eyes should be bright, clear, and full. As the fish become stale, the eyes become cloudy and often turn pink.
3. The gills should be red and free from slime.
4. The skin should be shiny with an unfaded color.
5. The odor of fillets and steaks should be fresh and mild.
6. Crabs and crab meat should have little fishy odor and no disagreeable ammonia-like taste or odor.
7. Crab shells should not be slippery.
8. Oysters and clams in the shell should be alive and the shells should close when handled.
9. The liquor of shucked oysters should be clear and there should be no sour smell or odor.
10. Fresh shrimp should have no disagreeable odor and their meat or shells should not be slippery.

Whenever in doubt as to the freshness of seafood, do not freeze it. If serious doubt is present, discard the seafood. Poor handling of fish prior to freezing will make it impossible to obtain good results. Freezing can only protect the quality of the fish as it was when frozen; freezing does not improve the quality. Frozen foods can be no better than the material one starts with. Do not purchase more seafood than can be frozen and stored in the available freezer space or more than your family will eat within 3-6 months.

SEAFOOD PREPARATION FOR THE FREEZER

When preparing seafoods for the freezer it is important that all inedible material and debris be eliminated. For example, fish should be scaled and the entrails and heads removed. Shrimp should be deheaded and peeled. This will allow additional space in the freezer and eliminate work prior to serving the dish for a meal. It is important that the seafood be packaged in just that amount which will accommodate or serve the family at one meal.

A technique we would recommend for preserving the quality is to dip raw seafood in a precooked and cooled solution of 5 percent starch. This will help exclude air from individual pieces. This can be done by using about 6 tablespoonsful of corn starch per gallon of water. The starch must, however, be rinsed away after the item is thawed and before cooking.

PACKAGING SEAFOOD FOR THE FREEZER

Choosing the right packaging material is a very important step in the process of freezing in the home. Most of the undesirable flavor and color changes in seafood are caused by oxidation. Loss of water during frozen storage, that is, freezer burn, not only dries and toughens foods but promotes oxidation (Figure 2). Freezer burn and oxidation are always accompanied by an off-flavor, off-odor, and off-color. The housewife should select packaging material that is impermeable to oxygen and water vapor and should exclude as much air as possible during packaging. Cling-type wrapping materials are an excellent barrier to both water vapor and oxygen, cling well to surfaces, and are available in most grocery stores. Metal cans with seal-on lids and glass jars designed for

Figure 2.—Typical case of severe freezer burn (dehydration).

freezing are good oxygen and water vapor barriers and are very useful for most seafoods.

Questions often asked are, "Is it a good practice to freeze fish and shrimp in ice cream cartons and milk cartons?" and, "Is it a good practice to freeze fish in pans of water?" (a common practice in the home freezer). The answers are, "Yes." Freezing fish and shrimp in ice cream or milk cartons is a good practice provided that the seafood is completely covered with an ice glaze and the cartons are tightly sealed to prevent the transfer of moisture and oxygen into and out of the package. These cartons are generally coated with wax or a plastic material and are excellent oxygen and water vapor barriers.

The importance of excluding as much air as possible from the package cannot be overemphasized. Besides preventing oxidation, air will act as an insulator and slow the freezing process. Any pocket of air between the package wall and the contents will promote the formation of ice crystals. When the package is cooled and frozen, moisture will move from the seafood to the inside wall of the package. If the product is warmed slightly during defrosting or each time the freezer door is opened, the moisture may move from the package surface back to the food surface. When the package cools again, the cycle is repeated. This may continue until a large quantity of water is removed from the food and it is severely dehydrated.

A warning is in order about thawing smoked or kippered fish. Never leave smoked or kippered fish in a tightly wrapped package after it has thawed. Some smoking methods do not ensure complete destruction of *Clostridium botulinum* spores, which may be harmful when smoked fish is stored unfrozen over a few weeks in an airtight container.

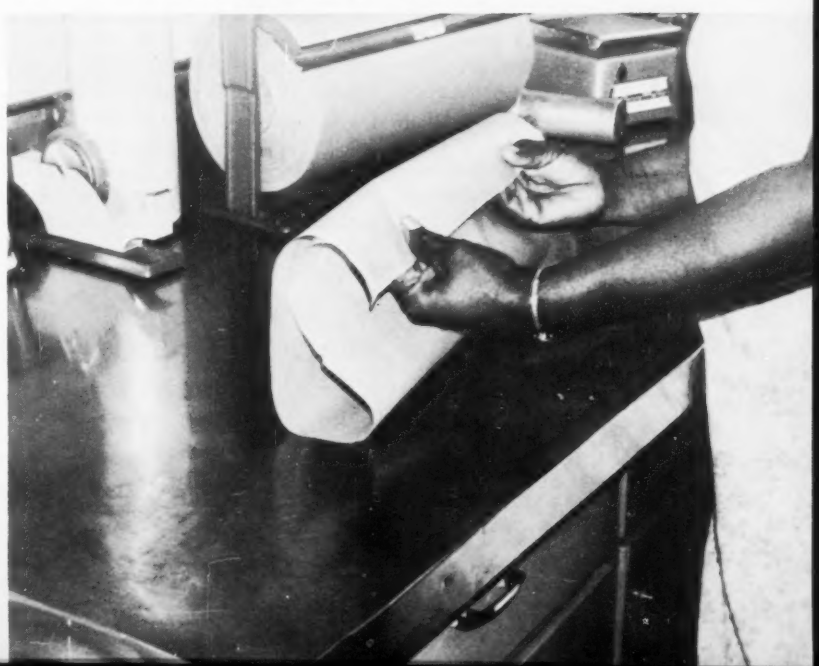
While it is advisable to package seafoods under vacuum, most housewives do not have access to this equipment. The next best thing is to wrap the seafood to exclude as much oxygen as possible. The drug store wrap is suggested (Figure 3). This is done by placing the item on the sheet of wrapping paper and bringing the ends together at the top and "roll the fold" until it is snug against the food. The ends should be folded in a similar manner while pressing out as much air as possible. The wrapping material should be secured with tape to prevent unfolding.

FREEZING AND STORING SEAFOODS IN THE FREEZER

The homemaker can save time, avoid losses, and make freezing seafood a pleasure by planning ahead. Check the freezer to see that it is functioning properly. To maintain the quality, adjust the thermostat to the coldest setting about 2 hours prior to anticipated use. Do not guess; check the temperature with a thermometer. Consider the size of the freezer. Generally, about 2 or 3 pounds of seafood for each cubic foot of freezer space will freeze in from 10 to 12 hours.

It is very important that packages

Figure 3.—The "drug store wrap" recommended for packaging seafoods for home freezers.



be placed in the freezer as soon as they are ready. Usually, the faster the food is frozen, the better the quality and the longer the storage life. This is partly due to less cell destruction by freezing. Slow freezing may actually allow bacterial and enzymatic spoilage to take place while the food is still in a semi-frozen state. To obtain the fastest freeze, place the packages in direct contact with the freezer floor or walls or coils until they are frozen. If the packages take more than 5 or 6 hours to freeze, they are probably too large. Packages should be stored at 0°F or colder where the temperature does not fluctuate. Generally, the farther away from the freezer door, the more stable the temperature.

Temperature fluctuation can be harmful to frozen seafood. Arrange packages in the freezer so that there is adequate space between them to allow good air circulation (Figure 4). Unfrozen packages surrounded by several other packages may not freeze for 3 or 4 days. If this happens, freshness will be lost and spoilage may occur. Never place unfrozen packages near frozen food. It may cause the frozen food to thaw. Leave the thermostat at the coldest setting until all of the packages have been frozen. Then maintain the temperature at 0°F or colder.

Although commercial packaging may allow over a year of good shelf life, freezing methods available in the home generally will not permit seafood to be stored that long and still maintain its flavor and texture. Most home-frozen seafood should not be stored over 6 months and not more than 3 months for salmon, crab, and shrimp. A good rule for a continuous supply of high quality frozen food is "first in, first out." Two to 3 months storage for all seafood is ideal. Seafood is very delicate in flavor and deserves to be eaten at the peak of quality.

Trying to guess the age and contents of a frozen package of seafood can be frustrating and wasteful. Many times food is discarded because the storage age is unknown. Although it is unlikely that properly frozen and stored food can become harmful at any age, top quality demands that extended storage be avoided. Label each package with the date, type of seafood, weight, and number of servings or pieces. A crayon or a grease pencil is ideal for this purpose. A record attached near the freezer will also be helpful and should carry the same information included on the package as well as the location of each package in the freezer, the package size, and a current record of the number of packages put into or removed from the freezer. This prevents unnecessary searching for a particular package and the harmful warming of the contents while the freezer door is open.

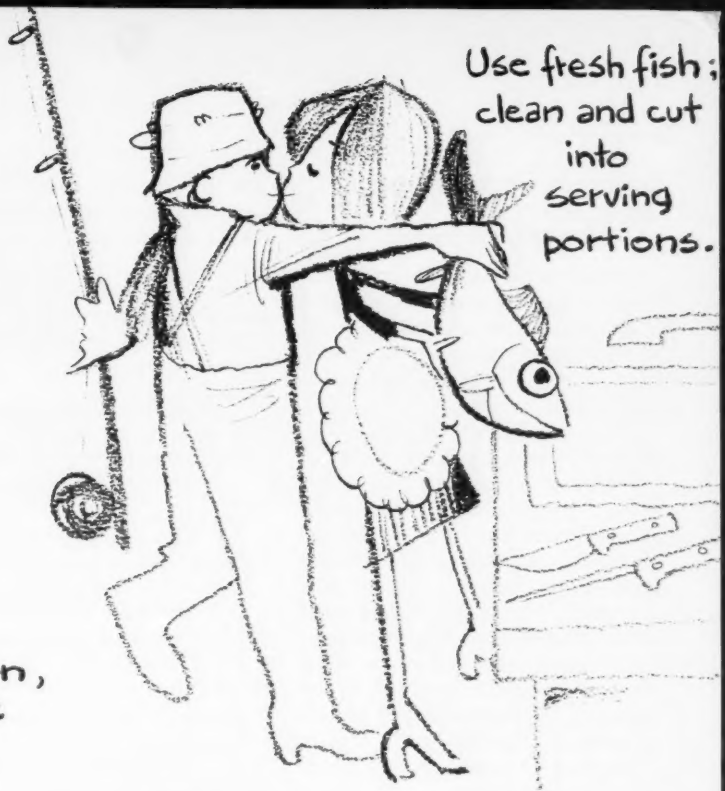
Figure 4.—Seafood properly spaced in home freezer to allow good air circulation.

PROPER USE OF THE FROZEN PRODUCT

The method of thawing seafood is almost as important as proper freezing. Usually the quicker a product is thawed the better, but *never in hot water.* Surface spoilage can take place quickly when thawing at room temperature or in warm water if the surface of the package remains at that temperature for several hours. Schedule thawing so that seafood will be cooked soon after it is thawed. Thawed fish may be held safely for a day in the refrigerator before cooking. Place the package of frozen seafood in the refrigerator to thaw. Allow from 18 to 24 hours for thawing a 1-pound package. If quicker thawing is desired, place the packages of frozen seafood under cold running water. Allow 2 hours for thawing a 1-pound package. Thawed seafoods should not be refrozen.

Some frozen seafood may be cooked without thawing. Breaded frozen fish should be cooked this way. In addition, frozen fillets may be cooked without thawing if additional cooking time is allowed. If the fillets are to be breaded or stuffed, they should be thawed before cooking.

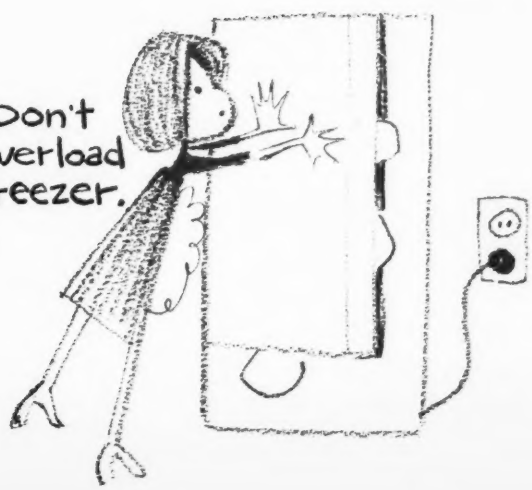
Tips on Home Freezing of Seafoods



Use fresh fish; clean and cut into serving portions.

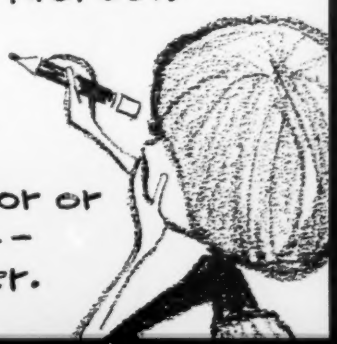
Starch solution, ascorbic acid deter oxidation.

Wrap securely, label and date.



Don't overload freezer.

First package in - first out.



Thaw in refrigerator or under cold water -- never in hot water.

GENERAL INFORMATION ON QUALITY OF THE FROZEN PRODUCT

A general knowledge of the causes of spoilage and spoilage characteristics of seafoods would help the housewife better serve her family and help her to better appreciate the meticulous care seafood must receive.

There are three major causes of spoilage in foods which are minimized or inhibited by the freezing process—protein degradation, oxidative rancidity, and brown discoloration (Maillard reaction). Protein degradation is caused mainly by autolytic and bacterial enzymes which are quite active about 40°F. This spoilage is characterized by ammonia and amine-like odors often experienced in spoiled meats and seafoods. These enzymes are protein in nature and mobilization or activity decreases as the temperature is reduced. Some enzymes remain active (activity is low), however, even at 0°F. A prime example of this is freezing corn on the cob without first blanching; heating inactivates the enzymes. In fishery products there is very little or no enzymatic degradation at 0 to −10°F and these products may remain palatable for many months, all other factors being equal.

The big problem in spoilage of frozen fishery products is rancidity. The uptake of oxygen and the onset of rancidity seems to be related to the unsaturation of the fat. Long ago, farm women learned to store their lard in crocks with as small a surface as possible exposed to the air and in a dark, cool place. Heat, light, oxygen, and the presence of heavy metal ions, such as copper and iron, enhance the development of rancidity. The oil in fish is long chain fatty acids containing many double bonds and consequently, it becomes very susceptible to oxidation. It is at these double bonds that atmospheric oxygen combines with the oil molecule to produce a variety of compounds such as ketones, aldehydes, acids, and many others that have not been identified.

Fish may be classified into three categories according to their oil content:

1. Those of low (less than 5 percent) oil content such as halibut, cod, flounder, and red snapper.
2. Those of moderate (5-10 percent) oil content such as mullet, croaker, and salmon.
3. Those of high (more than 10 percent) oil content such as herring, mackerel, and lake trout.

Fish possessing a high oil content will become rancid in three months in a freezer unless precautions are taken. Moderately oily fish become rancid in from 5 to 8 months, and fish with a low oil content become rancid in from 9 to 12 months. Freezing alone will not prevent rancidity but will slow down the reaction considerably.

Treating fish with an antioxidant coupled with vacuum packaging will increase the shelf life. Antioxidants we have experimented with, and which display excellent results, are butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), ethylenediaminetetraacetic acid (EDTA), 3′, 3-thiodipropionic acid (TDP), and propyl gallate. Other good antioxidants (which can be purchased at the grocery store) are ascorbic acid and citric acid. We recommend that ascorbic acid be used to soak the fish prior to freezing. The fish should be soaked in a 0.1 percent solution for about 1 to 2 minutes, frozen, and then glazed with this solution. A second glazing is advisable. The fish may then be wrapped as previously described.

The third type of spoilage encountered in frozen fishery products is the browning reaction. This reaction is particularly prevalent when white-fleshed fish are steaked or filleted. Extensive research has shown that this is a non-enzymatic reaction caused by a combining of certain amino acids with reducing sugars. The work showed further that the pentoses (5 carbon sugars) react readily with amino acids which contain sulfur, those amino acids being methionine, cysteine, and cystine. Lysine is also involved. The reaction is characterized by the presence of a brown color much like that of brown wrapping paper. The reaction is inhibited by treatment with antioxidants such as ascorbic acid and TDP.

Our experimental work (Thompson and Thompson) has shown that when red snapper fillets were treated with TDP and subsequently vacuum packaged and frozen, the reaction was completely inhibited for up to 12 months whereas the controls turned brown in 2 to 3 months. Bleaching of the red pigment in the skin of frozen snapper fillets was also inhibited by the antioxidant.

Seafood is very tasty, nutritious, easy to prepare, economically priced, and commands high priority on a list of preference for any family meal. Consequently, these delicacies of the sea deserve to be served at their peak of quality. We say to the commercial processor, "keep the product clean, keep it moving, keep it cold, and keep it stored at a temperature sufficient for proper preservation of the product." This is good advice to the homemaker freezing seafood for her family in the home.

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MFR PAPER 1027

This longline technique lets tropical fishermen work snapper concentrations more intensively.

A Vertical Longline for Red Snapper Fishing

DAVID A. OLSEN, ARTHUR E. DAMMANN, and DON NEAL

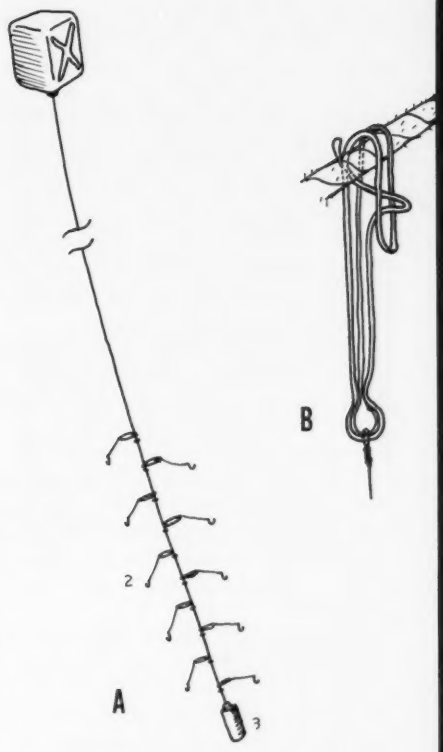

Figure 1.—A vertical longline (A) is constructed of a float (1) attached to 100-200 fathoms of 0.25-inch polypropylene line. Tuna gangions with hooks wired on them (2 and B) are placed every fathom up from the 5-lb weight (3) on the bottom. Knots between the hooks prevent the gangions from bunching up when big fish are hooked. From 15 to 20 hooks wired to gangions gave best results.

INTRODUCTION

Tropical inshore fisheries are confronted with two basic problems. Firstly, biological communities within the tropics tend to be diverse (MacArthur and Wilson, 1967). This diversity means that, unlike temperate fisheries which can concentrate on large populations of single species, tropical fisheries must be flexible. Fishing gear must be able to capture a variety of species to be effective in the reef environment.

The second characteristic of most tropical fisheries is a strong reliance on the small boat. In a survey of the South Pacific, Clutter (1971) found this to be the general case. Recent fishery development within the area has concentrated on improving this unit of fishing gear rather than introducing new levels of technology.

A similar situation exists in the Caribbean. Dammann (1969), Brownell and Rainey (1971), Swingle, et al. (1970), and Sylvester and Dammann (1972) have described the fisheries of the region to this effect. The present report is based on the idea that to be effective, fisheries development must find ways of maximizing and diversifying the catching ability of the basic unit of gear, the small boat.

This study was made in cooperation with the National Marine Fisheries Service, Public Law 88-309, and the Bureau of Sport Fisheries and Wildlife under the Dingell-Johnson Program. Additional support came from the Virgin Islands Government, the Dave Hokin Foundation, and the Marine Resources Development Foundation. This paper represents Journal Contribution 0003 of the Puerto Rico Inter-National Underseas Laboratory.

MATERIALS AND METHODS

The basic program of exploratory fishing is described in Brownell and Rainey (1971). The technique utilizes a 35 ft New England-style lobster boat for drift fishing on the edge of the Virgin Islands' shelf. Fishing is done with electric snapper reels.

The vertical longline was developed to enable the fisherman to concentrate his efforts on the highly discontinuous schools of snappers which are first located by electric reel fishing. Once one of these schools is encountered, the longline is let over the side and from 15 to 20 baited hooks, wired with 6-in leaders to longline snaps, are clipped to the line about every fathom of the ¼-inch polypropylene line (Figure 1). We tried a variety of hooks, wiring methods, and baits but ended up using from 15 to 20 No. 7 circle hooks, wired loosely to the snap. Knots

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were tied between hooks to prevent the snaps from bunching when larger fish were hooked. A 5-gallon plastic fuel container (Jerry Jug) was used as a float with a 5-lb weight at the other end. The extra flotation would carry the line if it fell off the edge of the shelf.

The fishing technique was to fish until multiple hookups were encountered with the electric reels. As soon as the last reel line was aboard, the longlines were let over the side and the pre-baited hooks snapped on about every fathom at the gunwale. By setting three sets of gear we could pull each one every 20 minutes although we had sets ranging between 15 and 75 minutes. The short sets were required because there are many sharks in this region which destroy gear left in the water too long. Gear loss generally increased with sets longer than 30 minutes.

The lines were hauled with a standard gasoline-powered fish trap hauler and if fishing was profitable the lines were immediately reset with another set of pre-baited hooks and snapons. At least one extra set of hooks was baited at all times. This was continued until such time as it was no longer profitable.

The total cost (excluding line hauler) was $100 for three complete sets of gear with spare hooks and snapons. This is roughly broken down as follows: Hooks ($10/100), snapons ($33/100), 1,800 ft of ¼-inch polypropylene line ($30), floats ($15), and the remainder on spare weights and baskets for coiling the lines on deck when not in use. A gasoline powered pot-hauler with reduction gears can be purchased for $260 and is proving to be very effective in our work with native-style boats in the 20 ft class.

RESULTS

Catches of over 100 lb of snappers and groupers per hour were recorded several times throughout the course of the study. This would pay for the gear in one hour. The largest fish caught were roughly the same size as those caught with electric reels. Two men used the gear in conditions that ranged from flat calm to 25-knot winds and 12-ft seas. No weather-related gear limitations were observed which were peculiar to this method.

The gear is extremely durable. During one stretch of three trips, gear loss was confined to less than 10 hooks. Sources of gear loss could generally be related to either sharks or handling problems.

The set lines caught fish 64 percent of the sets (49 out of 77 times). The most frequently caught fish were red snappers, groupers, and jacks. The general size and species composition of the catch was similar to that from electric reel fishing (listed in Brownell and Rainey, 1971).

The effectiveness of the gear decreased with the length of the set (Figure 2) and ranged downward from a high of 0.04 fish/hook/minute. A regression of catch rate with length of set was marginally non-significant ($F = 3.06$, df = 1, 75; $0.05 < P < 0.1$). This suggests a fishery strategy of 15 to 40 minute sets. All gear losses related to damage from sharks occurred during sets greater than 40 minutes in duration.

DISCUSSION

A method of fishing for red snappers and groupers has been presented which increases fishing effectiveness over electric reels by permitting the fisherman to work concentrations of these fishes more intensively. It is particularly effective in areas where predation upon caught fish prevents the use of the conventional bottom set longline. Although longlines and setlines have been used in the snapper fishery previously (Carpenter, 1965; Suarez-Caabro, 1970) these have been of the conventional bottom set type. Other workers (Jarvis, 1935; Whiteleather and Brown, 1945) stated that they were not successful in catching commercial quantities of snappers. Jarvis (1935) attributed this failure to strong currents and rough bottoms. The present gear was fished in these conditions (of strong current and rough bottom) with notable success. Since Kristjonsson (1969) makes no mention of this method of fishing, it may be relatively new. Use of vertical setlines permits

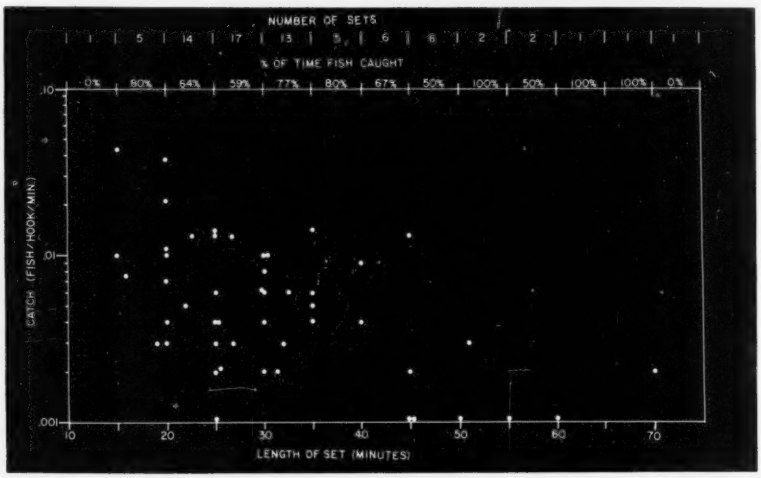

Figure 2.—The catch rate (fish/hook/minute) appears to decrease with the length of the set. The number of sets within the time interval is shown on the top line and the percent of those sets that were successful, i.e. caught fish, is shown immediately below. Only successful sets are shown.

the small boat to maintain mobility on the fishing grounds. The buoy serves as a point of reference for boat maneuvering since this fishery usually occurs in deep water away from accurate land marks. The high currents in this region (up to 2 knots) had little effect on catch. The gear itself is inexpensive and requires little supporting equipment other than a power line hauler. The lines have been hauled by hand with some success. The setlines are inexpensive to purchase, durable in use and easily operated from a small boat.

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MFR PAPER 1028

A close relationship is found between long-finned squid distribution and bottom water temperatures.

Aspects of the Distribution and Abundance of the Long-Finned Squid, *Loligo pealei*, Between Cape Hatteras and Georges Bank

FREDRIC M. SERCHUK and WARREN F. RATHJEN

ABSTRACT

Variations in distribution and abundance of the long-finned squid, Loligo pealei, *found between Cape Hatteras and Georges Bank were analyzed for the years 1967-1971. Spring catches of long-finned squid were greatest at depths from 111 to 183 m; in the fall the squid were most abundant at depths of from 27 to 110 m. A close relationship was found between the distribution of long-finned squid and bottom water temperatures. Best catches of squid were consistently made at locations where the temperature was above 10°C. Variations existed between day and night trawl catches, with daytime catches about nine times nighttime catches. Squid were larger in size during the spring than in the fall. The relative apparent abundance during the spring averaged 5.2 thousand tons compared to 22.7 thousand tons in the fall. It is probable that recruitment accounts for most of this increase. When the fall estimate is adjusted for inshore populations and the differences in diel catch rates, the fall apparent abundance is calculated to average 60,000 tons. Total standing stock cannot be determined without additional information.*

INTRODUCTION

Loligo pealei Lesueur, known variously as the long-finned squid, common squid, bone squid, and the winter squid, is abundant in waters off the eastern United States. *L. pealei* is a neritic species inhabiting the waters over the continental shelf, and is one of five Atlantic members of the genus *Loligo*. The species has recently received much attention in Northwest Atlantic fisheries.

Intensive fishing operations by Japan, Italy, Spain, Federal Republic of Germany, Cuba, the Soviet Union and others, have resulted in record harvests of long-finned squid in the waters between Georges Bank and Cape Hatteras. A National Marine Fisheries Service (NMFS) Market News Report (B-8, Jan. 11, 1973) indicated that in 1971 the Japanese catch of squid "off New York" amounted to 15,000 metric tons with an additional 5,000 tons harvested by the Spanish. Yet, despite this surge of commercial activity, knowledge of the ecology and life history of this squid remains limited.

Literature pertinent to the biology of *L. pealei* stocks between Cape Hatteras and Georges Bank has been reviewed by Mercer (1970a); Summers (1969), in collaboration with NMFS, determined the relative abundance and winter distribution of *L. pealei* in Atlantic coastal waters during 1967 and 1968; Vovk (1969) reported on a large number of trawl collections taken between 1958 and 1968 by AtlantNIRO. Mercer (1969a, 1969b, 1970c) analyzed the long-finned squid catches taken by the *A. T. Cameron* in otter trawl surveys on the continental slope of the western Atlantic and provided observations on the temperature-depth distribution of the species.

Using NMFS groundfish survey data, Edwards (1968) estimated the standing crop of long-finned squid to be approximately 318 thousand tons for the area between western Nova Scotia and Cape Hatteras. Summers (1969) provided estimates of the overall abundance of long-finned squid in the Middle Atlantic Bight at 3.4 (1967) and 2.1 (1968) thousand tons. He emphasized that these were minimum estimates and indicated that the largest biomass of squid was in the 110 to 183 m depth zone.

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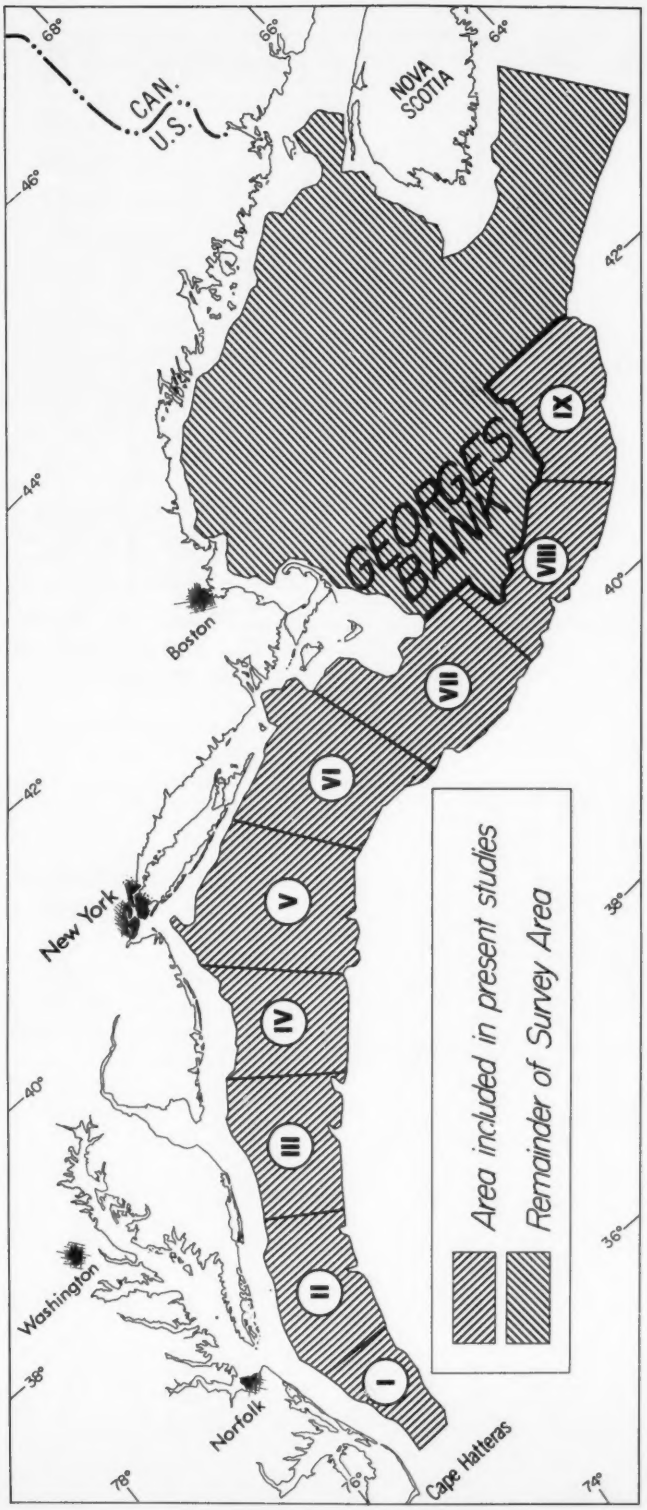


Figure 1.—Atlantic region sampled by semi-annual *Albatross IV* surveys showing coastal zones included in this study and the entire groundfish survey area.

DATA AND TECHNIQUES

The NMFS's Northeast Fisheries Center has conducted a semi-annual trawl survey of the fishing grounds between the 27 m and 366 m isobaths from Nova Scotia to Cape Hatteras since the fall of 1967. Operations have been performed using the fishery research vessels *Albatross IV* and *Delaware II*. Each cruise covered an approximate surface area of 75,000 square miles. A general description of the gear and methodology employed in the trawl survey program is provided by Grosslein (1969).

In brief, standard 30-minute otter trawl hauls (3.5 knots towing speed) were accomplished at randomly preselected stations within each of 58 strata (Figure 1). Sampling was organized according to a stratified random design which permitted a minimum of two stations per stratum. The total number of stations sampled differed for each cruise (Table 1), but the sampling scheme provided unbiased availability estimates for individual strata and sets of strata. Catch data for *L. pealei* from nine of these cruises and the relation of catch to geographical area, depth, and bottom water temperature are presented in this paper. Comparisons between spring and fall catch patterns are also documented.

Table 1.—Inclusive dates for spring and fall *Albatross IV* survey cruises, 1967-1971.

Year	Season	Dates	No. of stations
1967	Fall	17 Oct—9 Dec	271
1968	Spring	4 Mar—16 May	262
1968	Fall	10 Oct—26 Nov	275
1969	Spring	5 Mar—10 Apr	266
1969	Fall	8 Oct—23 Nov	276
1970	Spring	12 Mar—29 Apr	289
1970	Fall	3 Sep—11 Sep	294
		15 Oct—20 Nov[1]	
1971	Spring	9 Mar—1 May	301
1971	Fall	30 Sep—19 Nov	303

[1] First leg of this survey operation was performed with research vessel *Delaware II* using same equipment and following same procedures as *Albatross IV*.

The survey data examined includes the results of 2,537 otter trawl stations between Cape Hatteras and Nova Scotia. The catch of long-finned squid amounted to a total of 7,483 kg. Of

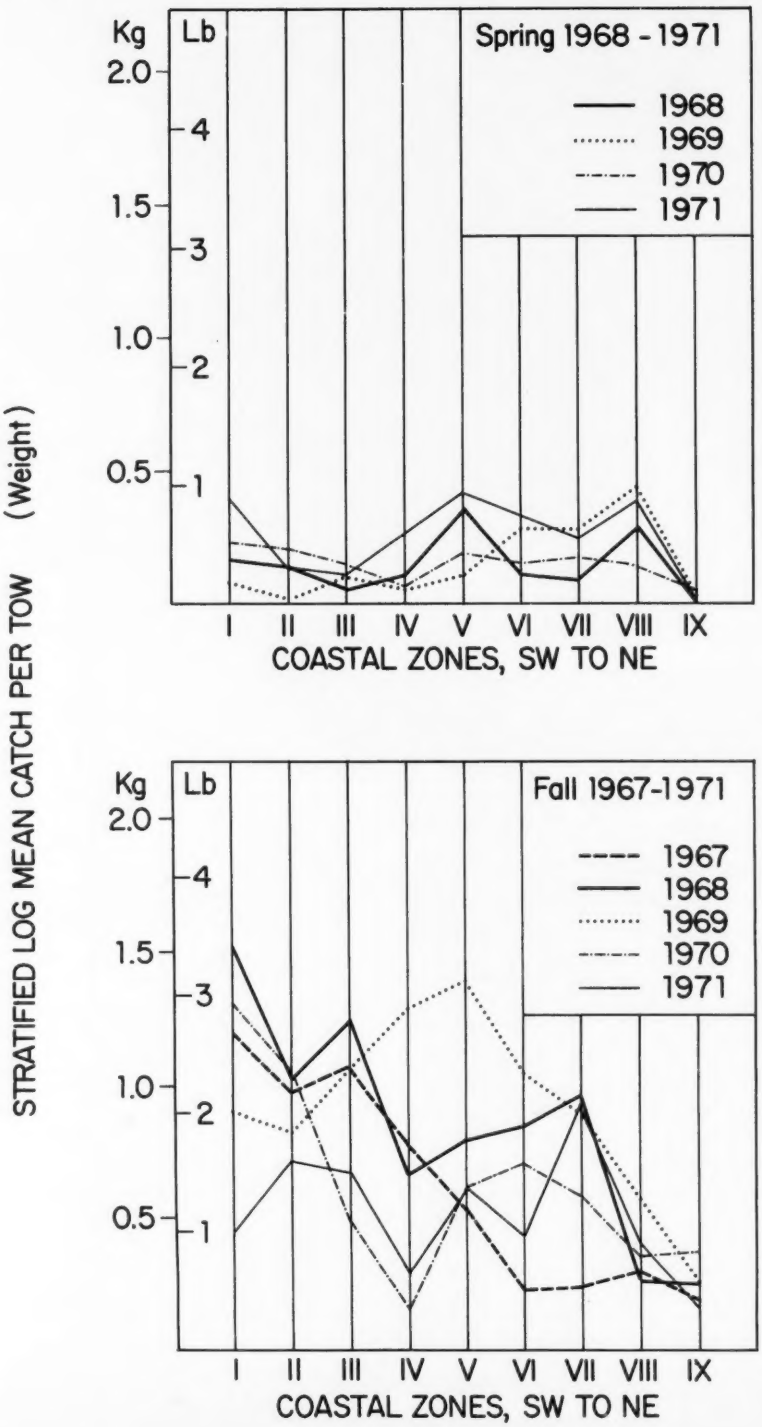
Figure 2.—Index of log mean catches of *L. pealei* per tow by coastal zones.

this total, 99.3 percent (7,429 kg) was taken in 784 trawl stations between the eastern portion of Georges Bank and to the south and west of Cape Hatteras; only these data are analyzed here.

The survey area between Georges Bank and Cape Hatteras was classified into nine coastal zones (designated by Roman numerals in Figure 1). Each zone possessed four sampling strata (except zones VIII and IX with only three strata) corresponding to the following depth range boundaries: 27-55 m (15-30 fm), 56-110 m (31-60 fm), 111-183 m (61-100 fm) and 184-366 m (101-200 fm). These area and depth classifications facilitated comparisons of data from similar regions from the nine cruises.

Catches of *L. pealei* were recorded aboard ship for each haul (sampling station). Routine data tabulated included total weight, length frequency, and total number of the individuals caught. Often, when large numbers of specimens were obtained, subsampling procedures were utilized. Concurrent with the biological sampling operations, hydrographic measurements were recorded for each station. These included bathythermograph casts which provided bottom temperature data. Upon completion of a survey, all catch information was transferred from trawl logs to magnetic tape permitting automatic data processing and computer summarization.

The stratified mean catch of *L. pealei*, calculated after a $\log_e$ transformation and expressed in terms of kilograms per tow, was used as an index of abundance. Log mean catch values have previously been employed in assessing *L. pealei* stocks (Summers, 1969), and are useful in evaluating species abundance trends when the frequency distribution of the catch is highly skewed (Grosslein, 1971). Such a positively skewed distribution was evident in squid catches in the present study and is frequently observed with other marine organisms.



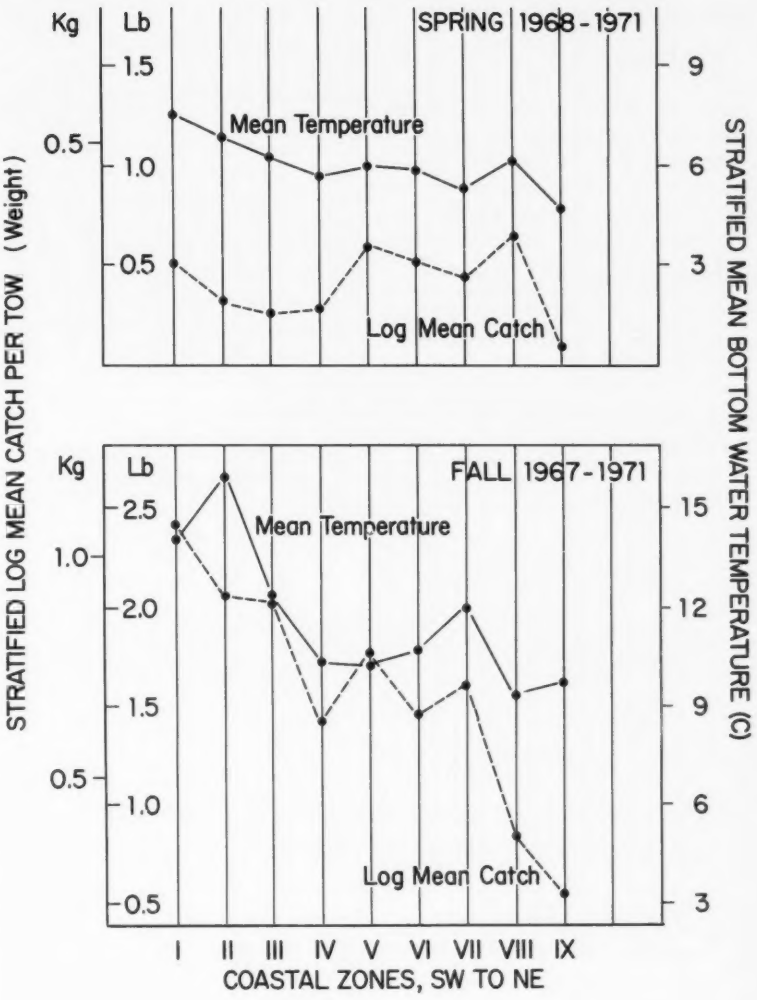


Figure 3.—Comparison of average stratified log mean catch of *L. pealei* per tow for the coastal zones sampled during the survey cruises, with the stratified mean bottom water temperatures recorded in each of the coastal zones.

Estimates of the relative apparent abundance[1] were derived for the Cape Hatteras-Georges Bank area for the spring and fall periods, and are presented later in this paper in Figure 6. The calculations were accomplished using the methods described by Edwards (1968) and involved the mathematical extrapolation of mean catch per tow data to obtain biomass values representative of the areas sampled. Briefly, the technique employed involves using the trawl catch results as representative of the area swept by the trawl; these amounts are then expanded by the area these trawl catches represent (strata) and minimum estimates for these strata are derived.

DISTRIBUTION

General

The long-finned squid is common to abundant on the continental shelf off the eastern coast of the United States. Mercer (1970b) provides evidence that it reaches Nova Scotia but occurrence north of there is questionable. In the south, this species ranges at least to Florida and the Gulf of Mexico and has been reported from various scattered areas in the Caribbean Sea (Voss, 1971). During the warmer months (May-October) the species is common in the inshore zone off the northeastern United States and western Nova Scotia. Soviet exploratory trawling to depths of 800 m between Nova Scotia and Cape Hatteras between 1958 and 1968 caught *L. pealei* most frequently between the 40 and 225 m depth zones. The frequency of trawl hauls with *L. pealei* in the catch was 47.7 percent. The range in size of the squid taken during this study was 5-45 cm (mantle length) with most of the squid measuring 8-22 cm (Vovk, 1969).

[1] Following the terminology suggested by Marr (1951), "relative apparent abundance" may be derived from catch per unit-of-effort data.

Table 2.—Log mean catch in kilograms of *L. pealei* per tow, by stratum.

Depth Zone		Coastal Zones, SW to NE								
Meters	Fathoms	I	II	III	IV	V	VI	VII	VIII	IX
					Spring 1968-71					
27—55	15—30	0.19	0.29	—	—	—	—	—		
56—110	31—60	3.30	1.65	0.22	1.06	1.76	0.77	0.22	0.33	—
111—183	61—100	7.04	5.83	5.83	4.84	5.83	4.62	4.62	5.46	1.39
184—366	101—200	4.07	2.31	2.53	1.10	0.95	2.00	2.60	1.72	1.07
					Fall 1967-71					
27—55	15—30	5.72	4.40	4.84	2.68	4.05	4.49	4.18		
56—110	31—60	4.49	4.66	4.00	3.70	3.39	2.03	3.56	2.20	1.36
111—183	61—100	2.14	6.16	3.34	3.56	5.19	5.50	2.38	0.79	0.26
184—366	101—200	2.46	1.89	1.85	2.29	2.68	1.85	0.79	0.62	

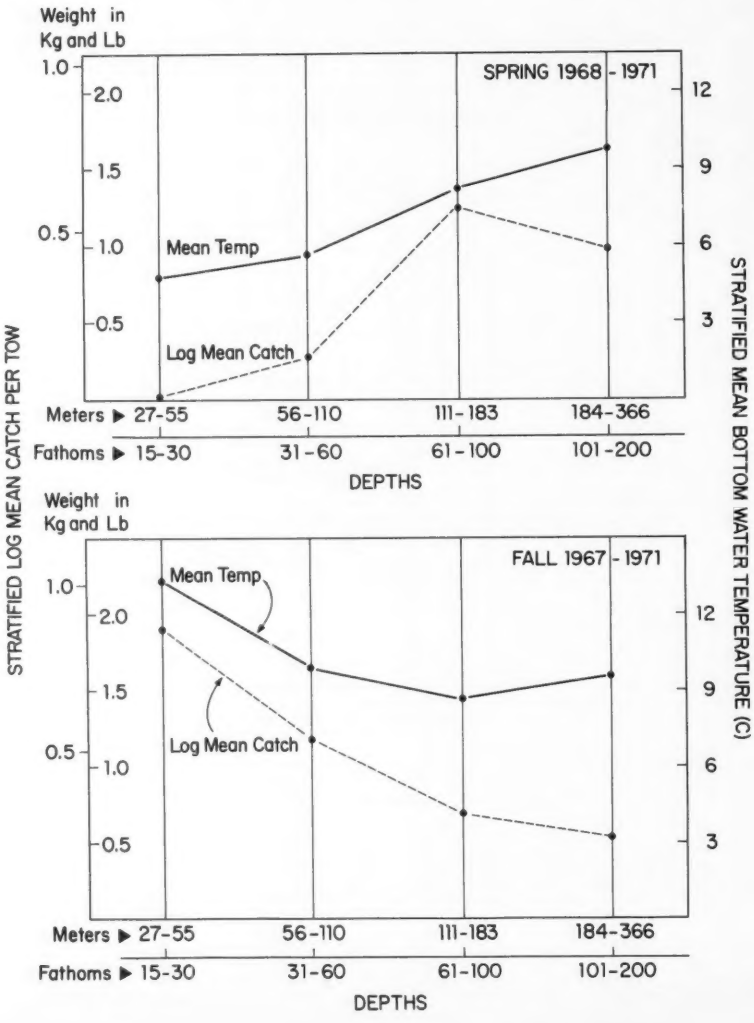
Geographic Distribution

The biannual surveys provide the ability to compare the distribution trends by coastal zone and general area. Stratified log means of *L. pealei* catches obtained for each of the nine coastal zones sampled during the spring and fall survey cruises are presented in Figure 2. Fluctuations in catches from the same coastal zone are sometimes apparent between cruises taken in the same season but general abundance patterns are also discernible.

In the spring, *L. pealei* is concentrated in coastal zones I (Cape Hatteras), V (Hudson Canyon), and VIII (southern Georges Bank). Catch rates dropped toward the eastern end of Georges Bank during each of the spring cruises and confirmed the similar patterns observed by Summers (1969) and Mercer (1969a). Eastern Georges Bank represents the approximate boreal limit of the long-finned squid during the March-May period of the surveys.

In the fall, *L. pealei* stocks exhibited a maximum abundance in the southern areas and generally diminished in magnitude toward the northeast. Catches usually were larger at Hudson Canyon (zone V) and Cape Cod (zone VII) than those taken in adjoining areas and probably are indicative of local aggregations of squid in these waters. Concentrations of *L. pealei* were invariably greater during the fall than they were in the spring. Presumably this was a result of an increase in population size resulting from recruitment, although seasonal differences in availability and trawl efficiency are believed to account for part of the apparent differences.

Figure 4.—Comparison of average stratified log mean catch of *L. pealei* per tow for the four depth zones sampled during survey cruises, with the stratified mean bottom water temperature recorded in each of the depth zones.


Weight in Kg and Lb
SPRING 1968 - 1971
Mean Temp
Log Mean Catch
Meters ▶ 27-55 56-110 111-183 184-366
Fathoms ▶ 15-30 31-60 61-100 101-200
DEPTHS
FALL 1967 - 1971
STRATIFIED LOG MEAN CATCH PER TOW
STRATIFIED MEAN BOTTOM WATER TEMPERATURE (C)

Bathymetric Distribution

Other investigations (Vovk, 1969; and Summers, 1967) have established that long-finned squid concentrate along the outer edge of the continental shelf during the months when inshore water temperatures are low (December-April).

Variations in catches of *L. pealei* with depth contrasted sharply between spring and fall; these differences are indicated in Table 2. Catch indices are presented by stratum to illustrate similarities existing between regions of equal depth in different coastal zones.

Relatively large concentrations of squid occurred in spring in depths of 111-183 m (61-100 fm). Abundance indices for this depth zone were several times greater than those for other depths in each of the nine coastal zones. Individuals were seldom taken in less than 55 m and were never obtained in shallow waters north of Chesapeake Bay (coastal zone II). These observations parallel the findings of previous investigators (Mercer, 1969a; Summers, 1969; Vovk, 1969), and are further substantiated by the large mid-depth (111-183 m) catches of long-finned squid taken by the

Japanese fleet off of New York during winter and early spring, 1971-1972.[2]

Observations on bathymetric distribution of *L. pealei* in the fall indicated that the species was dispersed throughout the area in waters less than 110 m. Concentrations inshore were generally higher than during the spring. A similar phenomenon observed during the autumn in the area between Block Canyon and southern Georges Bank was noted by Vovk (1969).

A segregation of individuals of similar size with depth was common to both the spring and fall distribution of squid. Larger individuals usually were found at greater depths than were smaller specimens. This relationship is evident in the fewer squid per kilogram obtained in deeper waters during both seasons (Table 3). Comparable observations on the correlation of squid size with depth have been previously documented (Summers, 1967; Mercer, 1969a).

Table 3.—Stratified mean number of *L. pealei* per kilogram obtained from the four depth zones sampled.*

	Depth Zones			
Cruise	27—55 15—30	56—110 31—60	111—183 61—100	184—366(m) 101—200(fm)
Spring 1968	103.6	30.4	17.2	13.6
Spring 1969	—	20.2	12.1	9.9
Spring 1970	66.6	26.0	29.5	13.4
Spring 1971	334.6	29.9	12.1	9.9
Fall 1967	43.3	30.6	13.0	12.1
Fall 1968	30.4	20.0	15.4	15.0
Fall 1969	36.3	18.7	15.4	17.6
Fall 1970	27.1	29.9	20.24	32.8
Fall 1971	52.1	51.5	69.7	46.4

*According to Summers (1969) "The data may be converted to dorsal mantle lengths by a rough rule of thumb: Five centimeter *L. pealei* are approximately 44/kg, 10 cm *L. pealei* approximately 22/kg, 15 cm approximately 11/kg, 20 cm approximately 5.5/kg, and so on. This rule applies to fresh animals of mixed sexes, but not to squid less about 5 cm dorsal mantle length nor mature animals all of one sex."

Distribution Related to Water Temperature

The presence and abundance of long-finned squid was strongly influenced by water temperature. The relationship of *L. pealei* with bottom water temperature is striking. This relationship was prominent for catch and temperature changes between coastal areas (Figure 3), as well as for changes noted with depth (Figure 4). Squid was generally more abundant at higher bottom temperature both seasons. Summers (1969) reported that major catches of long-finned squid were restricted to a bottom temperature of 8°C or higher during winter. Observations of catch in relation to bottom temperature in the present study suggest that a similar situation exists during the spring and fall (Figure 5). During both seasons the catch of *L. pealei* was greatly diminished in strata with bottom temperatures below 8°C. The largest

[2] Personal communication with NMFS personnel and Boston Market News Report.

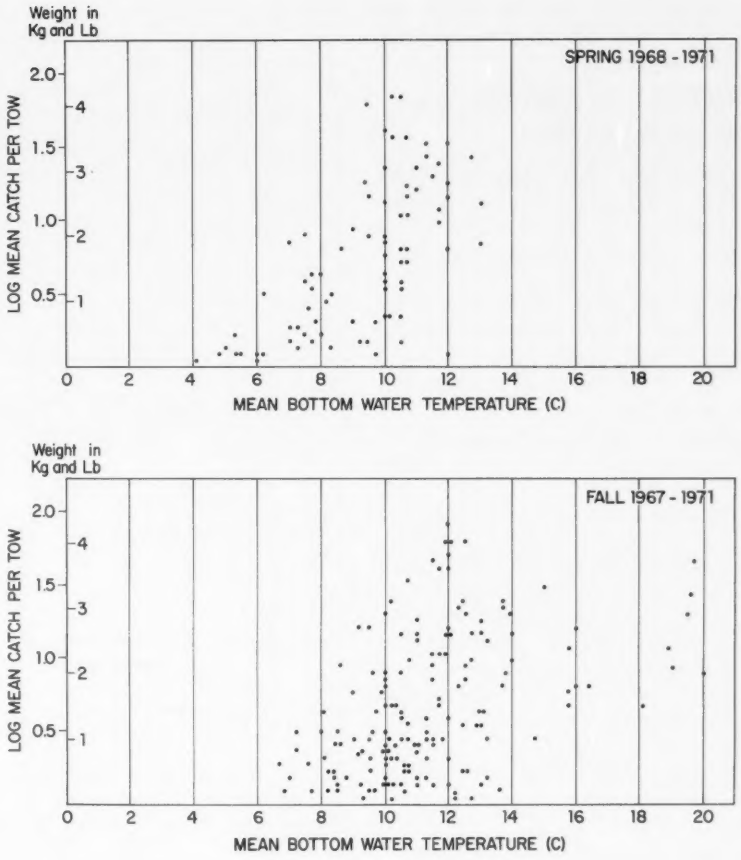
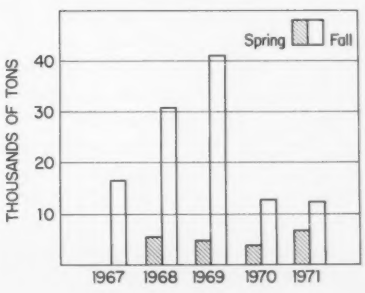


Figure 5.—Log mean catch of *L. pealei* per tow for strata sampled during the survey cruises, as a function of bottom water temperatures.

Figure 6.—Relative apparent abundance of *L. pealei* in the Northwest Atlantic (Georges Bank to Cape Hatteras) for spring and fall, 1967-1971.



catches of squid were taken in waters 10-12°C in the spring and at 10-14°C in the fall.

INDEX OF ABUNDANCE

Seasonal Variations

Variations were observed in the relative apparent abundance between spring and fall seasons. In the spring season there is a consistency from year to year for values of biomass to range well below 10,000 tons. They averaged 5.2 thousand tons for the years 1968-1971 (Figure 6).

In the fall there was a sharp contrast to the values derived for the spring months. The average aggregate weight estimate for *L. pealei* stocks in the area between Georges Bank and Cape Hatteras was 22.7 thousand tons during the years 1967-1971. During the period 1967-1969, there was a steady increase in the fall index of *L. pealei* but successive estimates of relative apparent abundance in 1970 and 1971 dropped to one-quarter of the 1969 level. Unfortunately, data are lacking on reasons for this decline.

Unadjusted relative apparent abundance of *Loligo* (tons).

	Spring	Fall
1967	—	16,790
1968	5,719	30,821
1969	4,878	40,998
1970	3,690	12,710
1971	6,599	12,058
Total	20,886	113,377
Average	5,221	22,675

For any given year, the fall index was several times greater than in the spring. Possible explanations of this phenomenon may be related to the size range of *L. pealei* during the two seasons and/or recruitment into the fishery. Representative size (mantle length) frequency data are provided in Figure 7. Reference to this figure demonstrates that in the spring the population sampled consisted of larger animals than during the fall. Winter fishing mortality may also contribute to the observed decrease in population size between these seasons. Additional

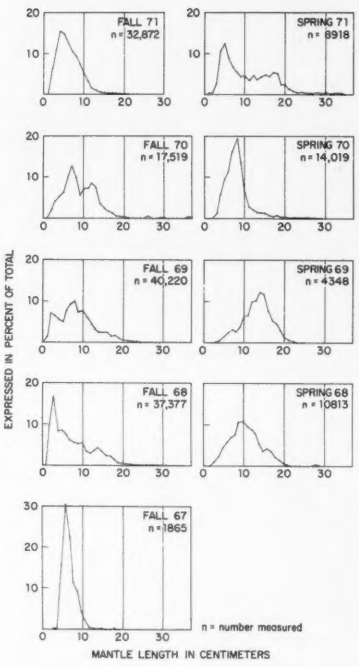


Figure 7.—Length frequency distributions of *L. pealei* taken on fall and spring cruises, 1967-1971.

research is required to delineate and evaluate the biotic and abiotic components influencing the abundance of this species.

It is interesting to note that preliminary evaluation of fall survey data for 1972 shows a strong upward trend from the 1970 and 1971 index values (mean log weight/tow).[3] This information suggests that the four years of moderate to heavy fishing on long-finned squid stocks has not, in itself, been responsible for the decline from 1969 values shown in Figure 6.

The regularity with which fall abundance indices exceed spring values appears to indicate that surveys during the fall season are more valuable in determining changes in abundance. It should also be mentioned that at least a portion of the long-finned squid stocks are distributed at depths shallower than 27 m (15 fathoms) which mark the inshore boundary of the survey area. There is no specific information available which allows estimates of the inshore component to be derived. One study, however, (Summers, 1968) indicates substantial numbers of long-finned squid present in Vineyard Sound in early November 1967, at depths of 20 m. Haefner (1964) records the presence of *L. pealei* in Delaware and Chincoteague Bays during the summer season. As the shallowest depth zone (27-55 m) sampled during the fall surveys accounts for about half the total, an equal or greater density in waters of less than 27 m could add up to 50 percent to the abundance index. This could bring the total apparent abundance to about 34 thousand tons.

Values for both the spring and fall squid populations must be considered as minimum estimates. There is very little information on the vulnerability of *L. pealei* to the trawl gear used in sampling the population, but presumably the effectiveness of the trawl is quite low. Low efficiency is not unusual when sampling pelagic and quasi-pelagic species (Edwards, 1968).

Diel Variation in Catch

Analysis of catch rates by time of day indicates a relationship between day and night catches (Figure 8). This feature of behavior has previously been pointed out by Summers (1969). The phenomenon of daily vertical migration by marine animals is well established in the literature. In the case of the long-finned squid it affects the catches by trawl gear which only samples a narrow band of 3-4 m over the bottom. It follows that estimates of abundance for species which rise off the bottom daily must be cautiously evaluated. We do not have positive information on the reason for long-finned squid leaving the bottom but it may be associated with pursuit of food (such as euphausiids) which are known to migrate in a similar fashion.

In the present study about 90 percent of the survey catch of long-finned

[3] Personal communication, M. D. Grosslein.

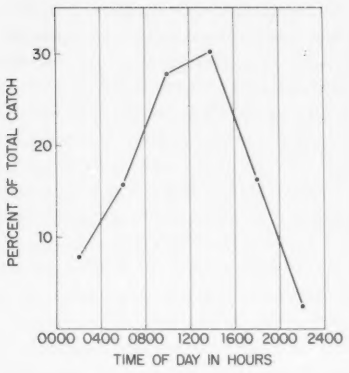


Figure 8.—Diel variation of catches of *L. pealei* survey cruises, 1968-1971.

squid was accomplished during daylight hours. If nighttime catches are increased by 90 percent to allow for squid which were unavailable at night and include our allowance for the population component that inhabited depths of less than 27 m, we will arrive at total calculated apparent abundance of about 60,000 tons for the fall season.

SUMMARY

The distribution and relative apparent abundance of *L. pealei* in the Georges Bank-Cape Hatteras area differed markedly during spring and fall. In the spring, the squid were located in modest numbers offshore in depths of 111-183 m, while in fall individuals were most abundant inshore at depths less than 110 m. This striking change in population can be accounted for by migration. Summers (1969) found that *L. pealei* migrate inshore in the late spring to spawn and return to deeper waters in the late fall. He also indicated that these fall migrations were a result of the species' intolerance to bottom water temperature below 8°C. The results of the present study corroborate Summers' findings and the similar observations reported by Vovk (1969).

Relative apparent abundance differences between *L. pealei* stocks in spring and fall were as prominent as the differences in distribution. The average spring biomass value was estimated to be 5.2 thousand tons and was similar in magnitude to the winter abundance of squid found by Summers (1969) in the mid-Atlantic Bight during 1967 and 1968 (3.4 and 2.1 thousand tons, respectively). The mean fall value was over four times as large (22.7 thousand tons) as that in the spring. Allowing for conservative expansion of the mean fall abundance index by virtue of squid located outside the survey area (inshore) and not captured by the trawl due to diel migrations, the calculated apparent abundance comes to 60,000 tons. This value does not take into account the availability of long-finned squid to the sampling gear. This information is not known at the present time. Until coefficients of availability and vulnerability are ascertained for *L. pealei*, all estimates must be considered tentative.

Data made available from the 1972 fall groundfish survey suggest that the downward stock fluctuations of 1970 and 1971 observed in this study are not necessarily fishery-related. The increase of commercial interest in sustaining a fishery for *L. pealei* necessitates that more research be undertaken to better understand the population dynamics of this species.

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MFR PAPER 1029

Comminuted fish flesh treated with certain salts serves as an effective binding material.

Solubilized Fish Muscle as a Food Binding Material

FREDERICK J. KING, FRED HEILIGMAN, and EUGEN WIERBICKI

INTRODUCTION

Several different binding materials have been used in the past for one food product or another. Among these materials, the most widely used for seafoods is a batter-breading combination in which the binding agent is usually a modified starch. It is used, for example, to manufacture fish sticks or portions and breaded fillets.

Comminuted fish flesh has been proposed as a binder material. Its advantages may include retention of binding qualities upon heating and minimal alteration in texture or taste of final product (Ronsivalli and Learson, 1973). This binder is prepared by grinding fish flesh in a silent cutter and then mixing it with water. Learson et al. (1971) recommended a ratio of 4 parts comminuted fish to 1 part water, but subsequently, they recommended much more dilute mixtures—fish:water ratios of 1:1 to 1:5 (Ronsivalli and Learson, 1973).

Physical treatments such as heating, degree of comminution of the flesh, and amount of added water alter the adhesive properties of this fish binder paste (Ronsivalli and Learson, 1973). The effect of these treatments on structure of muscle proteins are well known (review by Hamm, 1960). Presumably, these physical treatments influence the performance of this fish paste binder in the same manner.

The properties of a fish binder should be influenced by chemical, as well as physical, modification of its proteins. This possibility is not considered in the descriptions of Ronsivalli and Learson (1973) or Learson et al. (1971). The ability of dissolved salts to solubilize muscle proteins is well known. A variety of salts have been used for this purpose in biochemical investigations of the properties of fish, rabbit, beef, or pork muscle proteins. The common effect of these salts is to provide a sufficient ionic strength to extract proteins from muscle. NaCl or KCl have been used more often than other salts for this purpose. A few salts, such as condensed phosphates, are particularly effective at equivalent ionic strengths because they react with specific muscle proteins. Thus, a combination of salt such as NaCl, and a condensed phosphate, such as sodium tripolyphosphate (TPP), might be more effective than either compound alone (Dyer, 1969).

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Fillet pieces covered with batter and breading, cooked, vacuum packed, and radiosterilized cryogenically. A commercial starch-based batter was used for the sample at left. A fish paste binder (minced fish and water) was used for the middle sample, and a solubilized fish binder (minced fish plus a 3 percent NaCl-0.5 percent TPP aqueous solution) was used for the sample on the right.

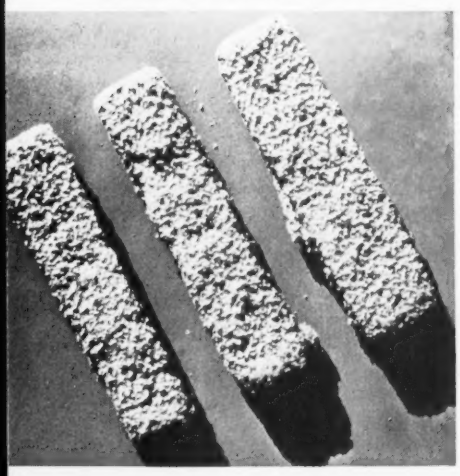
Based on these considerations, an estimate was made of the minimum amounts of NaCl and TPP that would solubilize muscle proteins in a "solubilized fish binder." Shults et al. (1972, 1973) found that a solution of 3 percent NaCl and 0.5 percent TPP had a greater water-holding effect on cooked meats than solutions containing less NaCl. Hellendoorn (1962) calculated that the ionic strength of this solution was 0.6. Dyer et al (1964) estimated that the ionic strength of fish muscle itself is 0.24. Thus a 1:1 mixture of comminuted fish muscle and solution containing 3 percent NaCl and 0.5 percent TPP is estimated to have an ionic strength of 0.42. A considerable amount of myofibrillar protein from fish muscle can be solubilized at 0.4 ionic strength although more protein can be solubilized at 0.5 to 0.6 (King, 1966). At ionic strengths of 0.4 to 0.6, the specific effect of TPP on swelling and moisture retention can be obtained in cooked meat (review by Dyer, 1969).

This estimate is also based on the assumption that ionic strengths can be calculated from molar concentrations of the salts involved. For completely ionized salts such as NaCl, this assumption is valid. However, a concentrated solution of TPP alone (12.5 percent) does not have the effect on fish muscle proteins that would be predicted by calculating its ionic strength from the molar concentration of TPP (F. J. King, unpublished work). Presumably, this discrepancy could be overcome by including activity of the TPP ion in the calculations. However, we are unaware of data which correlate activity of the TPP ion with its molar concentration.

Thus, the purpose of this investigation was to test experimentally the assumption that a solution of 3 percent NaCl and 0.5 percent TPP could be used with minced fish muscle as an effective binder.

Cobalt-60 irradiation source in water storage pool at U.S. Army Natick Laboratories, Natick, Mass.

Fish sticks made with solubilized fish binder and commercial breading.



MATERIALS AND METHODS

Solubilized fish binder was prepared by mixing minced fish flesh with an aqueous solution containing 3 percent NaCl and 0.5 percent TPP (both salts food grade). The fish flesh was minced in a silent cutter or obtained from a meat-bone separator and strainer (King and Carver, 1970). Pollock was used most often but other teleost fish sources should provide equivalent results (Learson et al. 1971). During preparation and use of this binder, we kept the temperature as low as possible without freezing since these conditions favor stability of fish muscle proteins (review by King, 1966). The storage life of this binder was not determined, but it has been kept for from 0 to 4 days at 3°C and performed satisfactorily afterwards.

Pieces of fresh fillets were dipped in the solubilized fish binder and then in Breader (Specialty Products, Inc., Cleveland, Ohio 44142). Then they

were cooked in a deep-fat fryer. Time-temperature conditions of this heat treatment were not critical as long as enough heat was supplied to cook the fish and set the binder (Ronsivalli and Learson, 1973).

Adhesion was measured by the coating defect method of U.S. Grade Standards as described in USDI (1963). The adhesiveness of the solubilized fish binder and Breader to fillet pieces was compared to other fillet pieces covered with a commercial batter mix, Batter Bind S (National Starch and Chemical Corp., New York, N.Y.) and Breader.

After this initial evaluation, the effect of the other preservation treatments was determined. Samples of the coated fillets with the covering were packaged under vacuum (appx 125 mm Hg), in epoxy-phenolic enamel-lined cans (404 × 309) and were given a radappertizing (radiation sterilizing) dose in the range of 3.2 to 4.0 Mrad using the NLABS Cobalt-60 source at a dose rate of approximately 30,000 rad/sec. The product temperature was held at −20° to −40°C during irradiation. After irradiation, the samples were stored at 21°C for 0 to 12 months before evaluation.

RESULTS AND DISCUSSION

Compared to a commercial starch-base binder, the solubilized fish binder had greater adhesion to surfaces of uncut muscle. Both binders adhered satisfactorily to freshly cooked fillet pieces. However, only the solubilized fish protein binder retained its adhesiveness after the further treatments of vacuum packaging, freezing, cryogenic radiosterilization and subsequent storage.

The solubilized fish binder performed differently from the fish paste binder of Ronsivalli and Learson (1973). The viscosity of the solubilized binder itself was much lower, even though both binders contained similar proportions of water and minced fish. It also produced a thinner, more flexible coating on fillet pieces. Presumably, this difference results from the effects of NaCl and TPP on ionic strength (estimated final value of 0.4) and in specific effects of TPP on solubilizing muscle protein. Adhesion of this solubilized fish binder to fillet pieces was slightly better than that of the fish paste binder under all the conditions tested.

Attempts were made to adjust the viscosity of the solubilized fish binder and thereby the thickness or flexibility of its coating on fillet pieces. Dilution with a 3 percent NaCl-0.5 percent TPP solution decreased the viscosity of this binder. With up to 5 parts of this solution per 1 part of minced fish, the binder was still effective in covering fillet pieces, and the products did not have a salty or bitter taste. Theoretically, one can increase the binder's viscosity by adding water. If enough water is added and time is allowed for the proteins to become equilibrated to the new ionic milieu, some of the proteins coalesce. However, this approach is less practical in preparing a binder than a direct mixing of minced flesh with a solution having a lower ionic strength.

Ronsivalli and Learson (1973) suggested several food products in which a fish paste is used as a matrix in which pieces of flesh are imbedded. We have not tested the solubilized fish binder for this specific application. However, its adhesiveness to fillet pieces leads us to suggest that, in a matrix application, it could provide a thinner more flexible material than a fish paste binder.

ACKNOWLEDGMENTS

We thank all concerned for securing the temporary assignment of Frederick J. King in the Food Irradiation Laboratory, U.S. Army Natick Laboratories, Natick, Mass., where this investigation was performed. We appreciate the assistance of Mr. Robert J. Learson, National Marine Fisheries Service, Gloucester, Mass., for communicating the results of his unpublished work.

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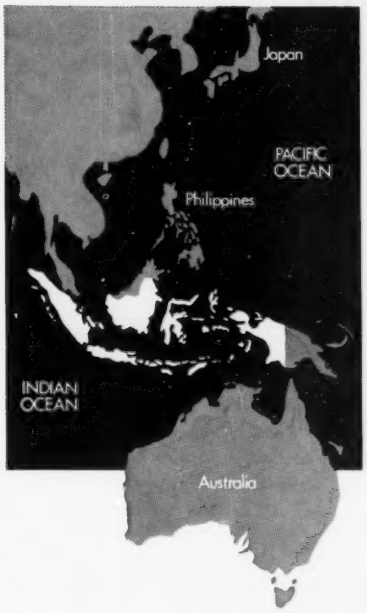
MFR PAPER 1030

An important shrimp fishery has blossomed in Indonesia since 1965.

A Review of the Indonesian Shrimp Fishery and Its Present Developments

M. UNAR



Location of Indonesia in white.

INTRODUCTION

Although there has been a shrimp fishery for a long time in Indonesia, it attracted special attention only after 1960 and grew rapidly some time after 1965 when modern shrimp fishing technology was introduced in Indonesian waters. Some of the methods of catching shrimp which have been applied locally for many years include the use of bottom gill nets, beach seines, the "chantrang" Danish seine, push nets, and tidal traps. The last mentioned method, which is conducted on a large scale along the east coast of Sumatra and particularly in the waters of the southern part of Malacca Strait, seems to be the most efficient. (See maps, pages 23, 24, and 25, for place names mentioned in the text.)

Although it was introduced earlier for experimental purposes, shrimp trawling started commercially only in 1966 in the waters of Malacca Strait, particularly in the area surrounding the estuary of the Rokan river, with Bagansiapi-api as its base. This fishery is characterized by the operation of wooden sampan-like motorized vessels of 5-20 GT employing a single Gulf-type shrimp trawl of 40 feet head-rope. This fishery developed rapidly and at the end of 1971 not less than 800 vessels, including some (less than 50) modern ones were operating in these waters. In the beginning of the development of this fishery, shrimp was the main objective. However, owing to the great demand for fish in the surrounding regions, such as Java which traditionally has become a market for salted fish processed from the catches of tidal traps in this region, the new shrimp fishery has finally developed into a conventional trawl fishery in which shrimp constitute the most valuable component of the catch. In the meantime there were increasing activities in the local shrimp fisheries along the north coast of Java and south Sumatra from which the landings were collected and taken to Jakarta. From there they were exported along with catches from other areas.

The great demand for shrimp in overseas markets has attracted the attention of not only domestic capital, but in particular of foreign capital as well. In 1968 joint ventures involving foreign capital were established in shrimp fisheries in several parts of Indonesia, particularly in the Sumatra, Kalimantan, and West Irian regions. This has given rise to the establishment of new small shrimp centers such as those in Kotabaru, on the island of Pulau Laut in southeast Kalimantan, Ambon and Sorong. At least 10 new cold storage plants for shrimp were installed throughout Indonesia in 1971. In these joint ventures some highly experienced companies, belonging to the four biggest Japanese fishing companies, are involved. Experience has shown that within a relatively short time they were able to adapt themselves to the local conditions, especially as regards the shrimp fishing grounds in the waters for which they are licensed to operate.

Marine scientist M. Unar has been associated with the Directorate General of the Fisheries of Jakarta for more than 15 years, and for the past four years has been Director of the Marine Fishery Institute in Jakarta. He is now a lecturer with the Faculty of Fisheries, Bogor Institute of Agriculture. Mr. Unar's paper is reprinted by permission and with full credit to the author, the Indian Ocean Program, the United Nations Development Program, and the Food and Agriculture Organization of the U.N. through John C. Marr, Program Leader, Indian Ocean Program, FAO. The paper has also appeared in a limited edition as NMFS Foreign Fisheries Leaflet No. 73-16.

However, these developments and the steadily increasing demand for shrimp have given rise to concern as regards the possibility of biological overfishing, as well as the possible overcapitalization in this fishery. It is unfortunate that, particularly in those regions with important concentrations of the shrimp fishery such as the east coast of Sumatra, catch and effort data on these industries are scarce. The catch and effort data available relating to new fishing grounds, although still incomplete, constitute basic material for the evaluation of the developments of this industry and for the planning of its further growth.

SOURCE OF DATA

Data on shrimp landings are compiled by the Directorate General of Fisheries from the data collected by Regional Fisheries Services. Since the compilation of these data has been carried out for a long time without being directly used in stock assessment studies, the data have not been collected in desirable detail. This is the case, for example, for the east coast of Sumatra and Java, while for some other areas only recently have shrimp been considered an important resource. Therefore exact figures on the total landings, the number and kinds of fishing gear employed, and, in particular, data on landings, specified according to species or groups of species and fishing gear, are lacking. Despite the difficulties encountered at the beginning, it is presently possible to compile data from new shrimp fishery centers, and more detailed information is expected after the establishment of the cold storage plants. In the meantime, efforts are being taken to improve the whole fishery statistical system.

In general the establishment of shrimp joint ventures is preceded by trial fishing or surveys which last for about one year. Such commercial surveys are supervised by the government and conducted by the Marine Fishery Research Institute in cooperation with the shrimp companies involved. The data obtained from these exploratory surveys are used in this report to analyze the shrimp fisheries in such areas as Kalimantan and the Arafura Sea.

THE SHRIMP FISHERY

Shrimp production from marine and estuarine fisheries in recent years is estimated at roughly 30,000-35,000 metric tons annually. Butler (1959) estimated these landings at around 26,000 metric tons, for the year 1955. Penaeid shrimps are fished in practically all the coastal areas of Indonesia. The most important species are: *Penaeus merguiensis*, *P. indicus*, *P. monodon*, *P. semisulcatus*, *P. latisulcatus*, *Metapenaeus monoceros* and *Parapenaeopsis* spp. Trade names, possibly originating from Australia and recently introduced by the joint ventures, include: banana prawn for *Penaeus merguiensis* and *P. indicus*, tiger prawn for *P. monodon* and *P. semisulcatus*. In some cases *Parapenaeopsis* spp. are also known as tiger prawn. *Metapenaeus monoceros* and *Penaeus latisulcatus* are called endeavour and king prawn, respectively. The greater part of the landings consist of *P. merguiensis*.

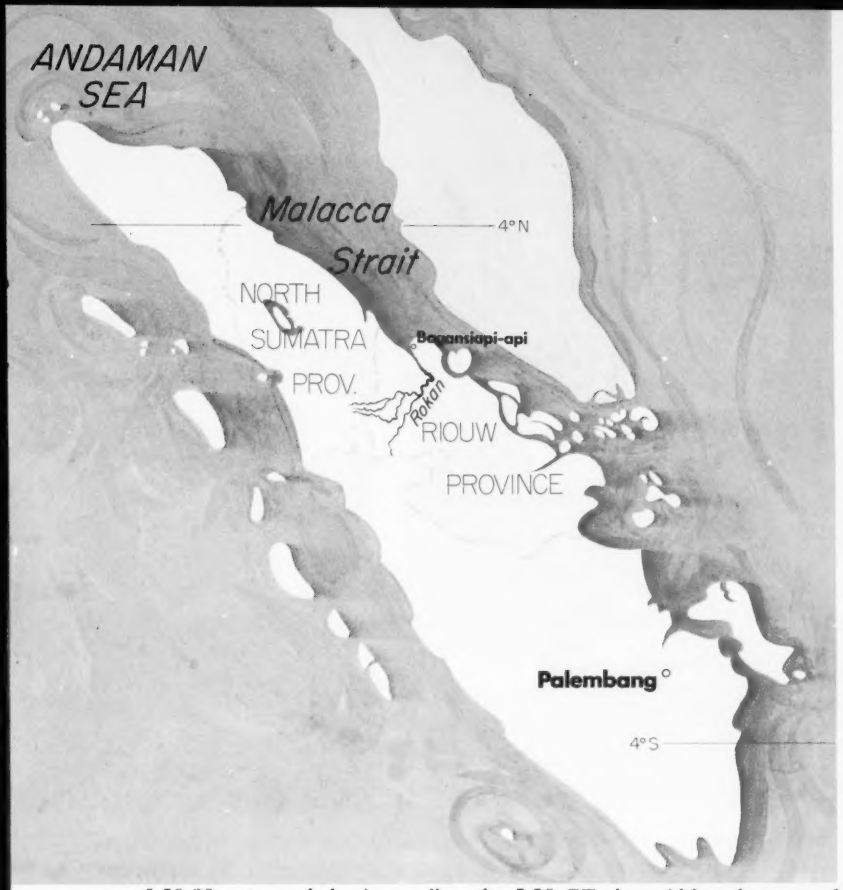
Another group of shrimp which occupies an important place in the production and diet on a national scale is the so-called rebon, jambret, or blachan, a mixture of the specimens of the order Myscidacae, *Sergestes* of the order of Decapoda, and juveniles of penaeid shrimp. From this mixture, which is normally caught along the coast near estuaries, shrimp paste is manufactured and is widely used in the daily diet. Its production must be fairly high in view of the wide use of shrimp paste, but this report does not deal with this group of shrimp.

The major part of the above-mentioned penaeid landings comes from the waters of the Indonesian Sunda Shelf, in particular the east coast of Sumatra, Kalimantan, and Java. Sumatra is the leading producer with a total landing estimated around 20,000-25,000 metric tons per year, followed by Kalimantan and Java in that order. In the eastern part of Indonesia, the new fishing grounds in the Arafura Sea on the West Irian coast are considered to be the best. The coastal areas facing the Indian Ocean do not produce shrimp in abundance. It is estimated that only around 300-500 metric tons are landed annually on the west coast of Sumatra and the south coast of central Java. In view of the differing conditions of the fishing ground and the differential development of the shrimp fishery, it seems appropriate to discuss the fisheries on a regional basis.

The East Coast of Sumatra

There is shrimp fishing along this entire coast (see map, page 23) but intense fishing is carried out only in the coastal areas between lat. 4°N-4°S and the heaviest fishing is concentrated in the southern part of the Malacca Strait. In this area the primary productivity is reported to be rather high. There is a weak northward drift current throughout the whole year, while a tidal current from the Andaman Sea becomes stronger with an increasing amplitude as it approaches the relatively narrow passage. Owing to the effluent of the rivers of Sumatra, the Strait is gradually becoming shallower and recent observations indicate an average depth of 6-53 m. In the southern part where the fishery is most intense the depth is 6-27 m.

In this area the coastal shrimp fishery is characterized by the use of tidal traps, mostly consisting of a conical net made of synthetic twines, with the mouth of the net placed between two poles inserted in the bottom of the sea in such a way that their plane is perpendicular to the direction of the tidal flow. Thus, the nets fish on both directions of the tidal current. Such nets are placed in rows, forming batteries in places with depths varying from 2-6 m. A unit consisting of a



Sumatra, showing locations mentioned in the text.

row of 50-80 nets, each having a diameter ranging between 5-8 m, is common. Around Bagansiapi-api, in the estuary of Rokan river, there are at least 500 such units. These conditions are almost identical to those prevailing in the coastal areas south of Malacca Strait reaching as far as lat. 4°S, although the number of traps in the south is less than those in the Strait. Since this gear is primarily employed for filtering "rebon," the mesh size of the codend is very small, ranging between 0.5-1.0 cm. Estuarine and other coastal fishes are the main catch, but "rebon" and penaeid shrimp are caught together in amounts between 5-80 percent of the total catch. The penaeids are dominated by *Parapenaeopsis* spp. followed by *P. merguiensis* and, in lesser quantity, by *Metapenaeus brevicornis* and *M. mastersii*.

The offshore southern part of Malacca Strait is the area in which the trawlers operate. These are generally flat wooden sampan-like trawlers of the 5-20 GT class. Although many of them are provided with winches, there are still those which use manually operated wooden rollers. Lately some modern double-rigged trawlers, with sizes ranging between 40-100 GT, were introduced in this area. Bases are scattered over the entire coast. In two provinces on the southern part of Malacca Strait, the Riouw and the north Sumatra provinces, the number of trawlers increased from 8 in 1966 to 830 at the end of 1971 (Table 1). As was mentioned earlier, this fishery is becoming a conventional trawl fishery although shrimp is still the highest prized catch. Unfortunately, except for information on the number of licensed vessels, no data are obtainable on the catch and effort and it is impossible to analyze the condition of the stock on the basis of this information alone. However, about 50 vessels have recently transferred their operation from this area to the north coast of Java, because, according to the operators, the catch rates in the Malacca Strait have been dwindling rapidly. This may be an indication of overcapitalization at the producers' level. Starting in 1968, a company with Japanese capital and technicians, based in Palembang, south Sumatra, operated a fleet of 26 relatively small shrimp trawlers in that coastal area. They have recently transferred their operations to east Kalimantan owing to low catches, which were estimated at around 5 metric tons (heads-on) per vessel annually. No detailed data were obtained during the course of their operations.

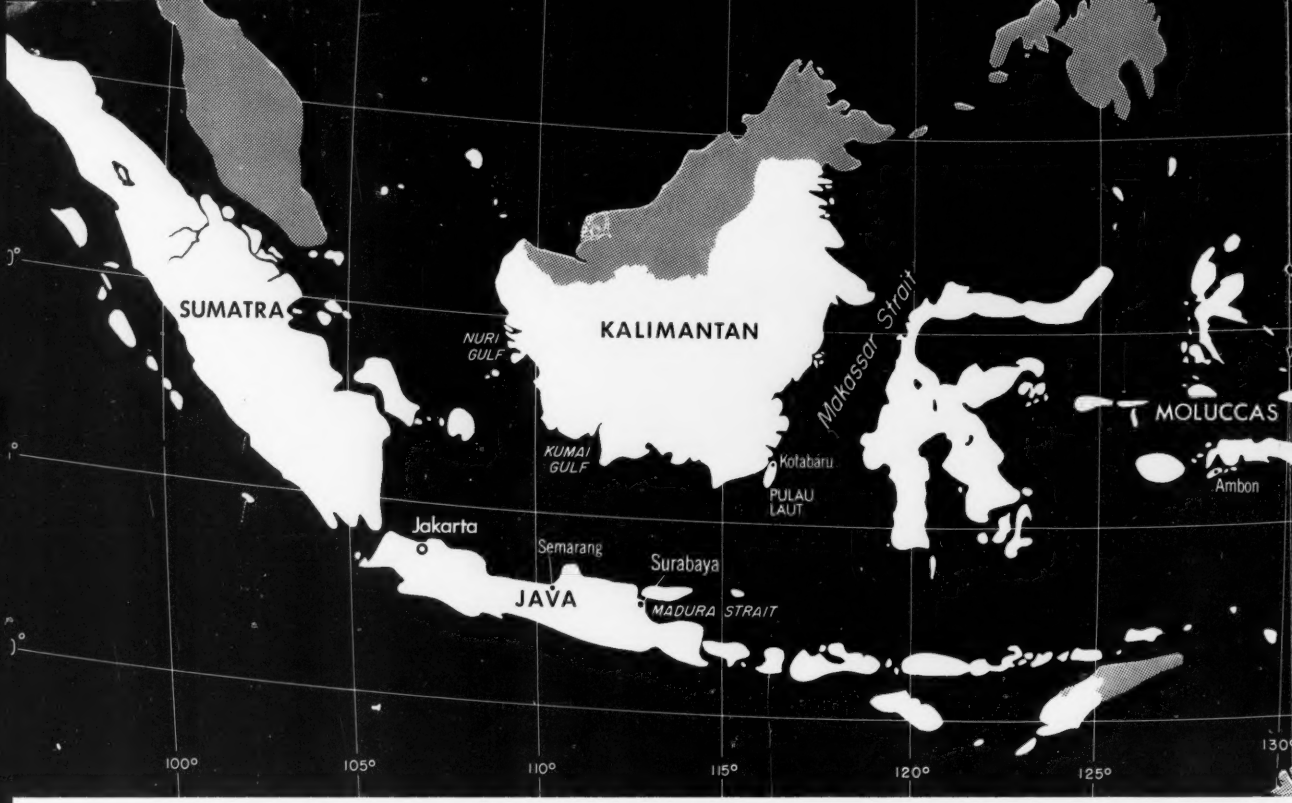
Table 1.—Number of trawlers licensed from the two provinces bordering the Malacca Strait, the Riouw and north Sumatra provinces, 1966-1971.

Year	Number of trawlers
1966	8
1967	59
1968	113
1969	363
1970	590
1971	830

It is worth noting that other fishing methods, such as bottom gill nets, Danish seines, and other kinds of traps, can be found all along the Sumatran coast and contribute substantially to the shrimp landings.

The North Coast of Java

The central part of the northern coast of Java, which in a way constitutes a bay, and the Madura Strait in east Java are the main fishing grounds for the coastal shrimp fishery. There are no large rivers flowing into the Java Sea in comparison with the south coast of Kalimantan which faces north Java across the Java Sea. The Java Sea, like other waters in Indonesia, is subject to the influence of the two monsoons; the East or Dry Monsoon from May to October and the West or Wet Monsoon from November to March. During the East Monsoon, winds come from the ESE and reach maximum force in June-August. During the West Monsoon,



Indonesia, showing areas of importance to the shrimp industry mentioned in text.

winds come from the opposite direction and reach a maximum in January-February. April and November are transitional periods with winds of less strength and unpredictable directions. The westbound surface current lasts from May to October, with strongest flow culmination in June. The eastbound surface current lasts from November to March, with a peak in February. The latter, although of shorter duration, is stronger and is associated with winds and generally heavy rains. As a consequence of these physical conditions of the sea, the shrimp are concentrated in the shallow coastal waters and trial fishing with a trawl failed to produce satisfactory results. Local fishing with bottom gill nets is more successful. At present this fishery is developing at a very rapid rate, but the recent annual landings of 2,500 metric tons should not be attributed to this fishery only, since shrimp catches are also made by varied other fishing gears of individual minor importance. In the last two years, new cold-storage plants have been installed in Jakarta, Semarang, and Surabaya.

The West and South Coasts of Kalimantan

Along the west coast of Kalimantan, particularly in the vicinity of estuaries, the coastal shrimp fishery presents the same characteristics, although in a smaller scale, as those prevailing on the east coast of Sumatra where tidal traps play an important role. In addition, some other gears, although much less efficient than tidal traps, are distributed throughout the Kalimantan coastal areas. Because there are large rivers flowing into the Java Sea, shrimp grounds are extended farther offshore as compared with the north coast of Java where the rivers are smaller. Local Fisheries Services estimate the present coastal shrimp landings at around 3,500 metric tons annually.

In 1968 a company with Japanese capital, the Kyokuyo Hogei, obtained a licence for shrimp fishing in the waters of south and west Kalimantan from a base in Jakarta. In order to determine whether the establishment of the investment could be commercially justified, it was preceded by trial fishing or surveys for one year. Two vessels of about 99 GT each were used as survey vessels. The survey commenced in May 1968 and concluded in April 1969. The area covered by the survey is shown in Figure 1. In 1969 it was decided to proceed with the enterprise and another vessel of 377 GT was added. In 1970 six vessels, five of which were of the 100 GT class, continued the fishing operations in this area and in 1971 thirteen vessels of the same size class constituted the total number of vessels employed by the company. However, in that same year the company expanded its area of operation to West Irian. Only two vessels operated the entire year in Kalimantan and the whole fleet of thirteen vessels had only 50 boat-months in this area.

The total landings showed an increase each year. Including the catches

of the survey period, the total landings (heads-off) were as follows:

1968	38,016 kg
1969	50,000 kg
1970	132,397 kg
1971	231,771 kg

Two vessels which were in full operations in this area in 1971 landed 61,582 kg and 61,127 kg respectively. The average catch-per-vessel in 1968 was 19 metric tons; in 1969 this decreased slightly to 16.7 metric tons; in 1970 it increased considerably to 22 metric tons; and in 1971 catch-per-vessel declined again to 17.8 metric tons. Figure 2 illustrates the course of the developments as described above. The drop in the landings of 1969 was due to the absence of the vessels after finishing the surveys, while the third bigger vessel, which started its operation in that year, failed to demonstrate its ability to operate effectively in shallow waters. The drop in 1971 must be attributed to the fact that a bigger part of the time of the fleet was spent in the waters of West Irian. The present operations are concentrated in relatively limited areas, i.e., in the vicinity of Nuri Gulf on the west Kalimantan coast and around the Kumai Gulf on its south coast, both in depths between 10-20 m, where the density of shrimp is highest.

In Figure 3 are shown the average monthly landings per vessel. In four of the months the landing per vessel (heads-off) was less than 3 metric tons. This catch rate could possibly be marked as a minimum target to be reached by vessels of about 100 GT.

The East Coast of Kalimantan

This coastal region faces the Makassar Strait, where there is a rather limited shelf and a continuous southward surface current. Several fairly large rivers discharge their waters into this Strait. During limited periods, trial fishing has already been performed by several companies, both national and foreign. Despite indications of the presence of favorable shrimp grounds in this area, it was not until 1970 that a company, formerly operating in south Sumatra, decided to start fishing in the southern part of this region, from a base at Kotabaru on the island of Pulau Laut, southeast Kalimantan. In 1970 only nine vessels were transferred from Sumatra and operated in east Kalimantan. In the following year the whole fleet of 26 vessels had transferred their operation. Most of these vessels are small 10-20 GT wooden vessels, some of which were built in Java. The above-mentioned fleet consists of 1 vessel of 80 GT, 3 of 60 GT and 22 of 10-20 GT. A mothership of 400 GT carries out the collection and processing of the catch. At the end of 1971 a cold-storage plant was installed at Kotabaru.

The total catch (heads-on) in 1970 was 75,214 kg and this increased in 1971 to 345,270 kg. The annual

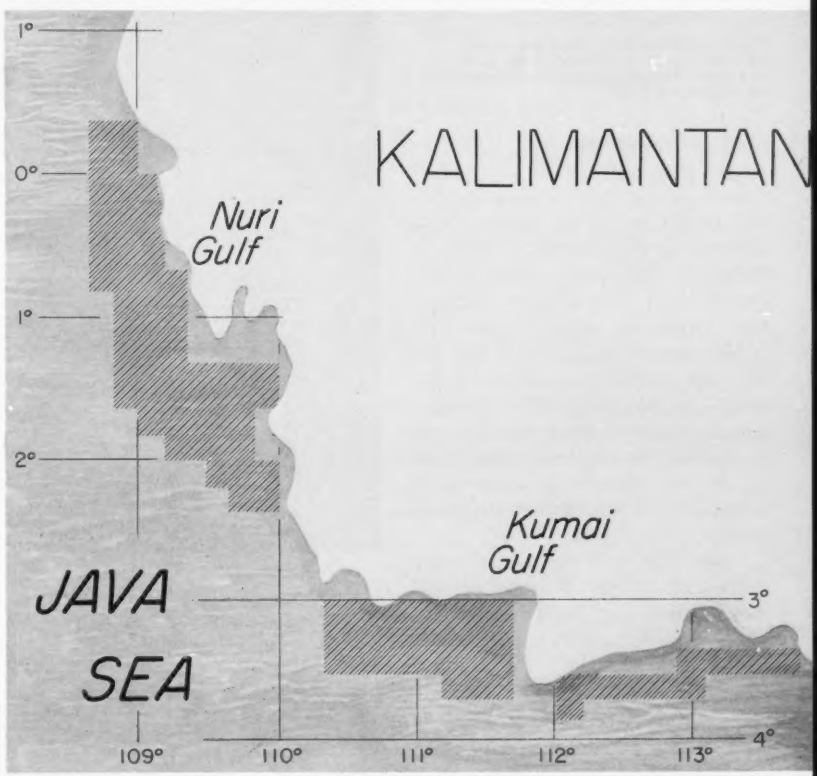


Figure 1.—Map showing the area surveyed in west and south Kalimantan 1968-1969.

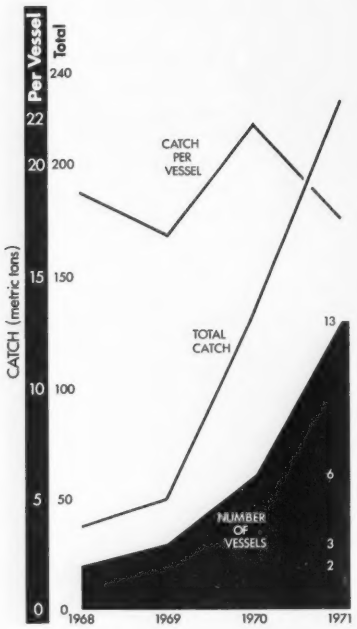


Figure 2.—Total catch, catch-per-vessel, and number of vessels-per-year, west and south Kalimantan 1968-1971. Shrimp weights are heads-off.

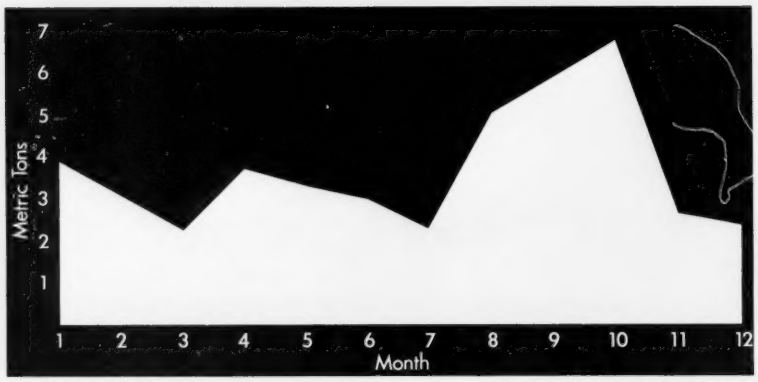


Figure 3.—Monthly average landings of shrimp by each vessel, west and south Kalimantan 1968-1971. Shrimp weights are heads-off.

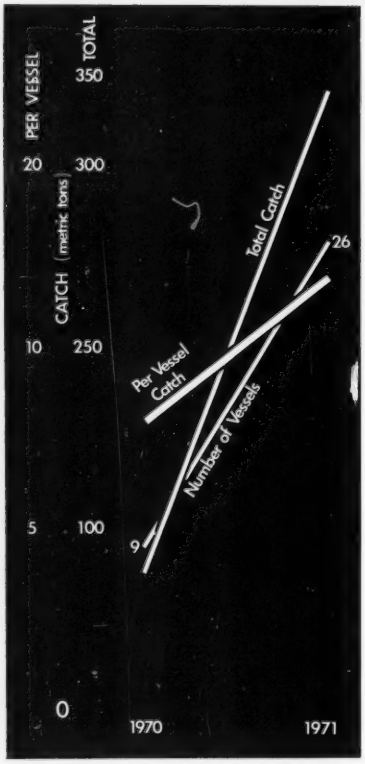


Figure 4.—Total catch, catch-per-vessel, and number of vessels-per-year, east Kalimantan 1970-1971. Shrimp weights are heads-on.

catch-per-vessel also rose from 8.4 metric tons in 1970 to 13.3 metric tons in 1971 (Figure 4) when the fleet was operating in full capacity. The monthly catch-per-vessel is shown in Figure 5. The period June-October of low catch rates coincides with the East Monsoon, during which the weather conditions are such that the full-scale operation of such small vessels is probably impossible. The fact that the catch rates on the east coast of Kalimantan are lower than those on the west and south coasts is, of course, due to the smaller size vessels used on the east coast.

Unfortunately, no surveys have been conducted in east Kalimantan like those in west and south Kalimantan. Essential data needed for the assessment of the shrimp stock in these waters are consequently lacking. Likewise, no detailed information on species or group of species of shrimp caught are available, except that banana prawn constitutes the main catch. The industry has expanded in 1972 with the addition of eight new ships.

The Arafura Sea

The local shrimp fishery practiced along the coastal areas of West Irian is limited to simple gears operating in the vicinity of towns only. The Arafura Sea of the West Irian area constitutes a large shelf situated between lat. 4°S and lat. 8°S along the southwest coast of West Irian and extends westward reaching the Aru Islands. It represents a favorable area

Figure 5.—Monthly average landings of shrimp by each vessel, east Kalimantan 1970-1971. Shrimp weights are heads-on.

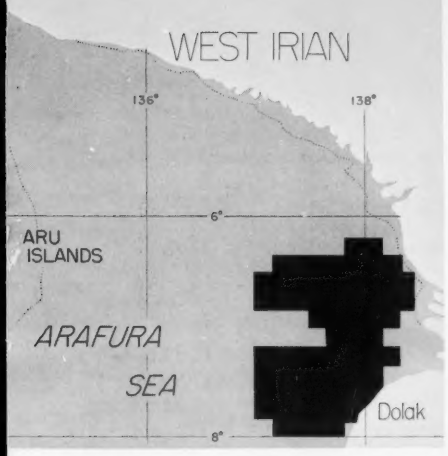


Figure 6.—Map showing the area surveyed in the Arafura Sea, West Irian 1969-1970 which is also the present main fishing ground.

for shrimp grounds in view of (1) the relatively wide area of shelf, (2) the number of rivers flowing from the hinterland of West Irian, and (3) the lack of strong currents.

Faunistic studies carried out by the research vessel *R. I. Jalanidi* in 1964 and 1967 revealed the presence of shrimp, in each of its hauls made by a 40-ft shrimp trawl and a 12-ft beam trawl, throughout the shelf at depths varying between 12-70 m. In 1969 two Japanese companies, the Taiyo and Nippon Suisan, started joint ventures from bases at Ambon in the Moluccas and Sorong in West Irian. As was the case with south Kalimantan, the actual operation was preceded by a survey or trial fishing which lasted for about one year. The area covered by these surveys is shown in Figure 6. Although the licenced fishing area covers almost all waters of West Irian, the actual operations thus far have been concentrated in the area where the surveys were carried out. Lately, several companies are trying to expand their operations to the east coast of the Aru Islands and the northern coast of West Irian, but so far the southern coast of West Irian (east of Dalak Islands) has thus not been touched yet.

In 1969 nine vessels were operating as commercial survey vessels; in 1970, 17 vessels; and in 1971 the number increased to 42 vessels, 70 percent of which are of the 100 GT

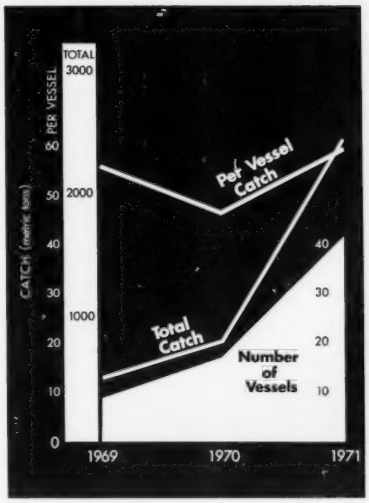


Figure 7.—Total catch, catch-per-vessel, and number of vessels-per-year, the Arafura Sea, West Irian 1969-1971. Shrimp weights are heads-off.

class and the remainder of the 300 GT class. The total landings (heads-off) included with the trial catches were:

1969	504,525 kg
1970	805,320 kg
1971	2,493,371 kg

The annual catch-per-boat was 56,056 kg in 1969, which in 1970 dropped to 47,247 kg and in 1971 rose again to 59,366 kg. The drop in 1970 was caused by the absence of the vessels after finishing the surveys, reducing thus the number of fishing days, while new vessels started their operations only toward the end of 1970 (Figure 7).

Penaeus merguiensis constitutes about 80-90 percent of the catch. Closer to the estuaries *Parapenaeopsis* spp. can be caught in big quantities, but the thick muddy bottom in such shallow waters prevents continuous operations. At the end of 1971 some new vessels arrived in these waters and surveyed the area east of the Aru Islands. From October until December 1971 six vessels of the 100 GT class have landed 201,216 kg of shrimp, of which 161,358 kg consisted of tiger prawn with *Penaeus semisulcatus* as the most abundant species. The monthly catch-per-vessel data are shown in Figure 8. There are three peaks in the course of the year which exceed 10 tons. An expansion of the fishery is expected in the coming years, following the installation of two cold-storage plants in Ambon and one in Sorong toward the end of 1971.

Figure 8.—Monthly average landings of shrimp by each vessel in the Arafura Sea, West Irian 1969-1971. Shrimp weights are heads-off.

ASSESSMENT OF THE STANDING STOCKS OF SHRIMP

Owing to the lack of appropriate data collections, it is possible to examine only the newly established Indonesian shrimp fisheries, for which there are appropriate data, in respect to catch and effort. Catch and effort data obtained from west, south and east Kalimantan and the Arafura Sea off West Irian show that the shrimp resources in these areas are still in the early stages of exploitation. To evaluate the future development and magnitude of these fisheries (say, to determine the maximum number of vessels for each area), the analyses of catch and effort data need to be continued and extended to provide information on the status of the stocks. An estimate of the total shrimp potential can be obtained from a resource survey carried out by a vessel. The catch rates-per-area covered by the gear, which provide minimum estimates of the

shrimp abundance in the track of the net, can be used to obtain a minimum estimate of the standing stock in the whole area covered by the survey. If the shrimp stock in the area is unexploited, it may be taken that the potential annual yield of this stock is at least equal to the standing stock estimate.

There were two surveys performed by the Marine Fisheries Research Institute in cooperation with shrimp joint venture companies: the first one in west and south Kalimantan and second in the Arafura Sea area. Although the surveys were made to assess commercial possibilities, except for some minor adjustments and faults in hauling, the net and hauling time were standardized.

The West and South Coasts of Kalimantan

The survey was conducted by two vessels. Only one, the *Akatsuki Maru*, a 99 GT steel trawler, completed the activities which started in May 1968 and terminated in April 1969. The vessel, which was originally a tuna longliner, modified as a double-rigged shrimp trawler, had the following specifications:

Length	28 m
Beam	5.20 m
Draft	2.40 m
Main engine	430 HP
Maximum speed	12 knots
Fish hold capacity	120 m^3
Contact freezer capacity	2 tons/day

The nets used throughout the operation, with some minor adjustments, were double polyethylene shrimp trawls with 65-ft ground ropes. The area under survey was primarily along the coast of west and south Kalimantan, where trawling is possible in depths between 8-25 m with most trawling concentrated between 10-20 m. The survey area was divided in grids of 100 square miles and the total area covered by the survey was about 9,000 square miles. The total fishing days were 254 days with 2,302 hauls and a total catch of 33,985 kg (heads-off). Most hauls were of 2 hours duration with a total of 4,582 hours of hauling (Table 2).

Table 2.—Number of days, hauls and catch (heads-off) by *Akatsuki Maru* 99 GT during the survey in 1968-1969, west and south Kalimantan.

Month	days	hauls	catch (kg)	catch per haul
May 1968	19	151	1,089.5	7.22
June	20	165	998.0	6.05
July	23	171	1,067.5	6.24
August	29	262	1,576.0	6.07
September	6	35	216.0	6.18
October	29	278	6,450.0	23.20
November	22	213	4,450.0	20.89
December	30	287	4,890.0	17.04
January 1969	22	222	3,846.0	17.33
February	28	269	5,078.0	18.88
March	19	184	3,056.0	16.61
April	7	65	1,268.0	19.51
Total	254	2,302	33,985.0	

The catch-per-haul was around 14.8 kg and the catch-per-hour was 7.4 kg. The width of the double net was estimated to be 30-40 m and the speed of the vessel was 3 knots. The area covered by the net is thus 0.048-0.066 square miles per hour. Escapement in shrimp trawling may be conservatively estimated to be 25 percent. The standing stock of shrimp is thus estimated to be about 1,261,364-1,734,375 kg heads-off or 140-193 kg per square mile. The catch composition is dominated by *Penaeus merguiensis*, with the biggest part belonging to the 26-30 per lb size group or 15.5-16.4 cm total length. There were indications that differences in the tiger prawn composition occur locally. The west coast, which is directly facing the West Monsoon, has tiger prawn catches of only 6 percent while catches on the south coast are considerably higher, reaching 35 percent. In both areas *Penaeus semisulcatus* was the most common species of tiger prawn.

The Arafura Sea, West Irian

The survey was conducted from May 1969 to March 1970. The *Izumo Maru*, owned by Nippon Suisan company and which was the first shrimp vessel entering these waters, was used as the survey vessel. The vessel, which was also a tuna longliner, is a 300 GT steel double-rigged trawler with specifications as follows:

Length	41.69 m
Beam	7.40 m
Draft	4.00 m
Main engine	570 HP
Maximum speed	12.3 knots
Fish hold capacity	157.3 m^3
Contact freezer capacity	4.8 tons/day

The trawl nets used throughout the survey were double polyethylene shrimp trawls having 85-ft ground ropes. The area under survey was from lat. 6°20′S-lat. 8°S on the Arafura coast of West Irian and extended offshore to long. 137°E. Fishing was carried out in depths between 10-40 m, with a concentration of effort at 17-28 m. This survey area was also divided in grids of 100 square miles and the total area covered by the survey was 6,500 square miles. The total fishing days were 228 days with 1,564 hauls and a total catch of 173,489 kg, heads-off (Table 3). Most of the hauls were of 2½ hours duration with a total hauling time of 4,000 hours. The catch-per-haul was about 111 kg and the catch-per-hour was 43.5 kg (heads-off). The opening of both nets is estimated to be 40-50 m at a speed of 3 knots. The area covered by the nets was 0.066-0.084 square miles. Escapement is also estimated at 25 percent. The standing stock in this area is thus

Table 3.—Monthly number of days, hauls and catch (heads-off) by *Izumo Maru* 300 GT during the survey in the Arafura Sea, West Irian 1969-70.

Month	days	hauls	catch (kg)	catch per haul
May 1969	16	104	4,959	47.68
June	21	118	21,422	181.55
July	25	158	28,738	181.88
August	22	126	31,369	248.96
September	20	150	17,290	115.30
October	21	140	17,148	122.50
November	21	151	14,345	95.00
December	31	238	13,442	56.48
January 1970	20	149	14,392	96.60
February	28	211	9,329	44.21
March	3	24	1,054	43.90
Total	228	1,569	173,488	

estimated to be about 4,207,588-5,355,023 kg or 647-834 kg per square mile.

The catch composition was dominated by *Penaeus merguiensis* roughly representing 90 percent of the catch, while the tiger and other prawn catches were low. The percentage size composition by weight groups of *Penaeus merguiensis*, as is presented in Figure 9, shows the size group at 26-30 per lb or a total length ranging between 15.5-16.4 cm constituted the highest

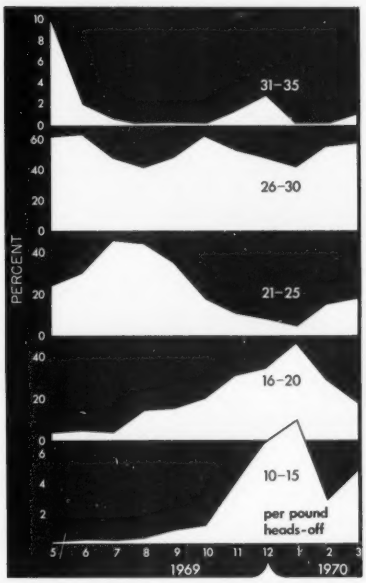


Figure 9.—Monthly size group by weight percentages of *P. merguiensis* landed by *Izumo Maru* during the survey in the Arafura Sea, West Irian 1969-1970.

percentage of the catches during the survey. Earlier observations in other shrimp areas indicated that this species spawns the year around with two peaks, one around March-April and the second around October-November, i.e., in the monsoon transitional periods. The absence of sharp drops in the monthly average catches by each vessel also clearly means that spawning occurs the year around. It is possible that the two peaks of the 31-35 per lb or a total length of 14.5-15.4 group were originally recruits from previous peak spawnings, reaching the age at about 8-9 months at the fishing ground. There is no clear explanation concerning the subsequent bigger shrimp except that the availability of the biggest size group may be attributed to the West Monsoon drift current.

DISCUSSION

Reviewing the general trends of the Indonesian shrimp fishery, a rapid development of commercial shrimp activities has taken place throughout the known shrimp grounds, which are mostly confined to the coastal shelf areas of the bigger islands where river outflow is relatively large. Regionally, the Arafura Sea on the west coast of West Irian is the best fishing ground, followed possibly by the southern part of Malacca Strait, Kalimantan, and Java in that order. However, no detailed data are available on most established local fisheries including the heaviest fishing areas such as the Malacca Strait and the north coast of Java.

In the new fishing areas, the early developments of the shrimp fishery includes increases in catch-per-vessel and in the total catches, except in the case of the west and south Kalimantan areas where the companies involved are still adjusting their operations taking into account the location and nature of the fishing grounds and the size of their vessels. As the present level of exploitation (1971) is about 50-60 percent of the maximum potential estimated for the Arafura Sea and about 13-18 percent of the potential estimated for West Irian, both Kalimantan and West Irian still provide room for expansion of the fleet, especially in the latter area where fishing is presently still centered in a certain limited area.

It is evident that *Penaeus merguiensis* is the most common species in the catch. During the early development of the new fishing areas, catches have been dominated by size group of 26-30 per lb or the equivalent of total lengths varying between 15.5-16.5 cm. It is most probable that spawning occurs the year around, while the strong West Monsoon drift current may play an important role in the availability of the biggest sizes in the shallow shrimp grounds. The tiger prawn, *Penaeus monodon* and *P. semisulcatus*, represent a smaller percentage in the catches, but in areas not directly facing the West Monsoon their importance is greater, as was shown in the catches of south Kalimantan and the newly discovered grounds on the east coast of the Aru Islands. Regional concentration of depths of fishing differs markedly due to the local physical conditions of each fishing ground.

MANAGEMENT

Various management measures can be introduced, toward the end of maintaining the sustainable yield or other management objectives, but serious consideration has to be given to the existing traditional fisheries and the economy of the shrimp industry. The effect of the various possible management measures depends to some extent on the growth and mortality rates of the smaller sizes of shrimp. Values obtained from estimates of shrimp mortality show a very wide range and some estimates are extraordinarily high. Because growth in young shrimp is very rapid, it would be beneficial if the young shrimp is protected, particularly in heavily fished areas. In an overexploited stock the protection of small shrimp will reduce the risk of depleting the adult stock to a level at which recruitment of the offspring might be seriously affected. Closed areas and mesh regulations for protecting small shrimp would not seem to be very effective and would be particularly difficult in existing traditional fisheries where, in most cases, the fisheries are concentrated in and around the estuaries with tidal traps and other gear using very small codends. However, considering the effect that this exploitation should have on the marine stock size and

catch, the enforcement of closed areas, closed seasons, or mesh regulations may appear to be profitable for the shrimp fishery as a whole. The establishment of closed areas for protecting the nursery grounds of juveniles of penaeid shrimp, generally around the estuaries, should be encouraged in the new fishing grounds. Aside from such protection of young shrimp, control of the amount of effort or fishing is very important and can be done through a catch quota, closed season, or direct regulation of fleet size. The difficulties in estimating recruitment variations for the short-lived shrimp could mean that catch quotas, which can be eventually coupled with closed seasons, are of little effect. It appears that the limitation of effort, such as the number of vessels or total tonnage of the fleet, is the most effective method of regulating the amount of fishing, not only from the standpoint of maintaining the productivity of the resource, but also from the standpoint of avoiding overcapitalization. In the future development of new fishing grounds, where there is still room for additional vessels and taking into account the fact that demand for shrimp will continue to increase (and price will continue to rise), the process of the increasing number of vessels must be controlled in such a way that the destruction of the stock and the economy of the industry can be avoided.

In order to facilitate management of the Indonesian shrimp fishery, it is necessary to collect data on catch and effort and on species and size composition of the catch. Prior to the establishment of this data base, management decisions will have to be based on less definitive information.

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MFR PAPER 1031

Trawls and traps capture red crabs of good quality off the Atlantic coast.

Observations on Distribution and Abundance of Red Crabs in Norfolk Canyon and Adjacent Continental Slope

PAUL A. HAEFNER, JR., and JOHN A. MUSICK

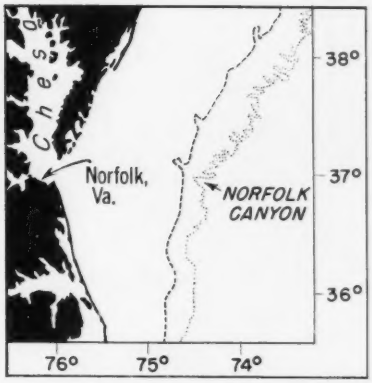
ABSTRACT

The results of June, 1973 trawl and trap sets in the Norfolk Canyon and adjacent slope area are summarized with respect to red crab (Geryon quinquedens) *distribution and abundance. Red crabs ranged in depth from 145 to 870 fathoms but were most abundant from 145 to 280 fathoms. This species was more abundant on the adjacent slope area than in Norfolk Canyon. Crabs caught ranged from 2 to 6 inches in carapace width. Most of the crabs were in the hard shell condition but a few peeler, soft, and papershell crabs were also caught, indicating that molting was occurring. The crabs were segregated with regard to sex. Deeper catches had more males; shallower catches had more females. A few ovigerous females were caught in both the canyon and slope area.*

INTRODUCTION

The red crab, *Geryon quinquedens* (Figure 1), occurs at depths from 100 to 1,000 fathoms in the western Atlantic Ocean from Nova Scotia to Cuba (Chace, 1940; Schroeder, 1959) and from 200 to 800 fathoms in the Gulf of Mexico (Pequegnat, 1970). *Geryon* is a relatively large crab, reaching a carapace width of 7 inches and a weight of more than 2.5 pounds (Wilder, 1966). A commercial processor in New England has realized a 23 percent meat yield (Galus, 1973).

Historically the red crab has been little-known and seldom utilized (Schroeder, 1959; McRae, 1961). Exploratory trawl fishing has confirmed the presence of concentrations of red crabs between 200 and 300 fathoms east to southeast of Ocean City, Md. (McRae, 1961). More recent explorations established that the red crab could readily be captured by pot or trap fishing gear in 250-500 fathoms near Hudson, Block, and Baltimore Canyons (*Delaware* Cruise Report 68-3, *Delaware II* Cruise Report 70-8). In fact, Meade (1970) has optimistically suggested that commercial quantities of red crabs exist in our offshore waters; what remains to be done is to develop that resource into a fishery. A more recent article (Galus, 1973) has brought attention to the paradox of a short supply of a superabundant resource. New England's first commercial producer of red crabs is finding it difficult to obtain a steady supply of crabs for its operation, due to the lack of fishing effort, either directly or indirectly, for red crabs.



From June 4 to June 16, 1973, scientists from the Virginia Institute of Marine Science conducted a trawl survey of the Norfolk Canyon and adjacent continental slope aboard the University of Miami research vessel *Columbus Iselin*. Data concerning the red crab resulting from this cruise are reported here.

AREA FISHED

Trawling was conducted within the Norfolk Canyon (lat. 37°00′-37°10′N; long. 74°10′-74°45′W) and on an adjacent slope area (lat. 36°32′-36°48′N; long. 74°25′74°46′W). A total of 47 half-hour trawls was made in depths ranging from 40 to 1,100 fathoms. Effort was distributed as follows: 25 trawls in the canyon (6 in less than 85 fathoms, 14 between 85 and 500 fathoms, and 5 deeper than 500 fathoms); 22 trawls on the slope (6 in

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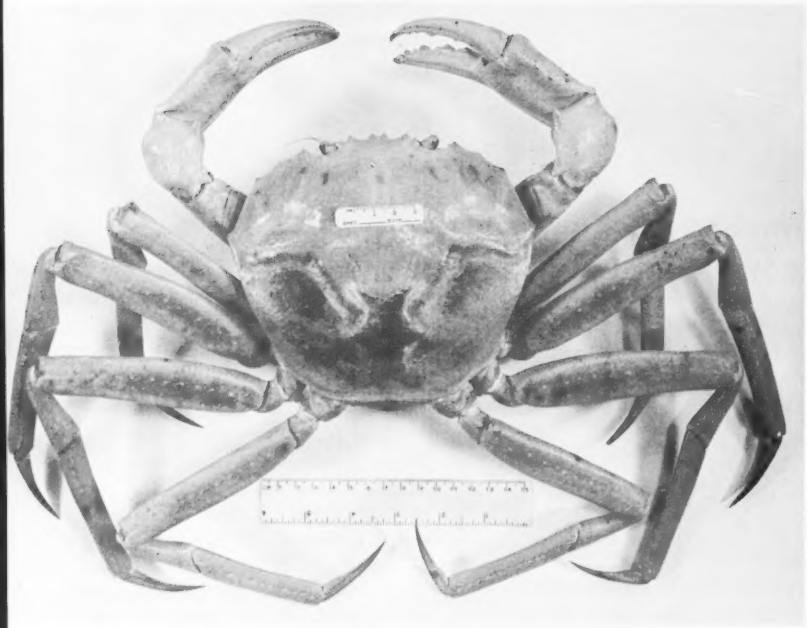

Figure 1.—A male specimen of red crab, *Geryon quinquedens*. A crab of this size can weigh as much as 2 pounds.

less than 85 fathoms, 12 between 85 and 500 fathoms, and 4 in 500 fathoms or more).

FISHING GEAR

The trawl gear used was 45 foot semi-balloon, four-seam otter trawls equipped with plastic mud-rollers, metal floats, and China-V doors. The trawl nets were constructed of nylon webbings of the following stretched mesh sizes: body, 1¾-inch; intermediate, 1½-inch; cod end, $1^{7}/_{16}$-inch with ½-inch inner liner.

In addition to trawling, 12 aluminized wire lobster pots (Figures 2 and 3) were set along the axis of the canyon in depths from 85 to 640 fathoms. The traps, provided by Ocean Research Corporation[1] of Kennebunk, Me. were of two sizes: 48 × 22 × 14 inches with a parlor on either side of a central bait chamber (kitchen) and 60 × 30 × 18 inches with two parlors in series behind the terminal bait chamber. Each trap was weighted to 110 pounds in air, fitted with a bridle and a $^{5}/_{16}$-inch braided nylon/polypropylene hauling line. A radar staff and two inflatable buoys were secured to the warp of each trap. Each trap was baited with four hake (*Phycis chesteri*) in two bait bags, and set for approximately 48 hours. Haul-back was accomplished with the aid of a hydraulic capstan but the line had to be hand-coiled into the storage tubs. Depending on the length of warp, from 30 to 60 minutes were required to haul each trap.

[1] Reference to firm name does not imply endorsement by the National Marine Fisheries Service, NOAA.

FISHING RESULTS

Nineteen of the 47 trawl catches had 706 crabs weighing 901 pounds. Individual catches ranged from 1 to 197 crabs (0.7 to 319 pounds; an average of 47.5 pounds per half-hour tow). The largest catch occurred on the slope area south of Norfolk Canyon in a trawl depth range from 192 to 254 fathoms.

Eight trawls in Norfolk Canyon netted 236 pounds for an average of 29.5 pounds per tow. Two of these drags, between 178 and 278 fathoms, accounted for 152 pounds or 64 percent of the canyon catch. Five trawls, between 330 and 580 fathoms, netted 84 pounds or 35.4 percent of the catch. Only one crab (less than one pound) was caught in 800-870 fathoms.

Eleven trawls on the adjacent slope accounted for 665 pounds for an average of 60.5 pounds per tow. Six tows between 145 and 280 fathoms resulted in 450 pounds, or 67.6 percent of the slope catch; five drags between 330 and 500 fathoms netted 215 pounds or 32.4 percent.

Nine of 11 traps caught red crabs (one trap was lost during haul-back). Of a total *Geryon* catch of 116.6 pounds, 63.4 percent (73.9 pounds) was taken in five small traps with a mean catch of 14.8 pounds; four large traps caught 42.7 pounds (36.6 percent and a mean of 10.7 pounds).

Four traps (two large, two small) set in 520-740 fathoms caught 47.7 pounds or 40.8 percent of the total. The small traps were slightly more productive (27.6 pounds, average 13.8; 23.7 percent of the total catch) than the 60-inch traps (20.1 pounds, average 10.1, 17.2 percent).

Three 48-inch traps in 325-480 fathoms accounted for 46.3 pounds, an average of 15.4 pounds per trap and 39.7 percent of the total. The two 60-inch traps at this depth caught 22.6 pounds, an average of 11.3 pounds—19.4 percent of total catch.

Two of the nine traps containing *Geryon* also caught deep water sharks, *Centroscymnus coelolepis*, and one trap caught a hake, *Phycis chesteri*. The two traps which did not contain *Geryon* were set in 89 and 98 fathoms. They were very successful in trapping jonah crabs, *Cancer borealis*, and rock crabs, *C. irroratus;* 15.4 pounds in the large one, 28 pounds in the 48-inch. The latter small trap also contained one 3-pound lobster, *Homarus americanus*.

SIZE OF CRABS

Crabs caught by trawl ranged from 1.75 to 6.25 inches in carapace width and weighed from one ounce to 2.5 pounds, respectively. The mean widths of crabs from both canyon and slope trawls were similar, i.e., approximately 4.5 inches. The traps were more selective as to size of individual crabs: 3.75 to 6.1 inch range with a mean width of 4.9 inches. The 0.4 inch difference in mean width between the trap- and trawl-caught crabs reflects an average weight difference of about 4 ounces.

We were concerned initially that the dimensions (5.5 by 7.5 inches) of the entrance funnel to the traps would limit the size of red crabs caught. In fact, the largest crab taken in the traps was 6.1 inches, slightly larger than that trawled in the canyon (6 inches) but smaller than that on the slope (6.25 inches).

REPRODUCTIVE ASPECTS

Crabs were segregated by sex. Rarely was a 1:1 male to female ratio approached. The trawl catches had more males (3:1 to 16:1) in the deeper strata (220-550 fathoms) and more females (1:2 to 1:3) in the shallower strata (80 to 220 fathoms). A few ovigerous females were captured on both canyon and slope and were present in both depth strata.

These ratios were somewhat reflected in the trap catches. Seven of eight traps between 400 and 640 fathoms contained all male crabs; the eighth trap contained eleven males and two females, one of which was berried. The trap set at 325 fathoms contained eight females (three ovigerous) and three males. The overwhelming number of males in the traps partially explains the larger mean size of crabs caught by traps as compared with those caught by trawls. Since females are smaller than males on the average, their presence in larger numbers in trawl samples would lower the expected mean.

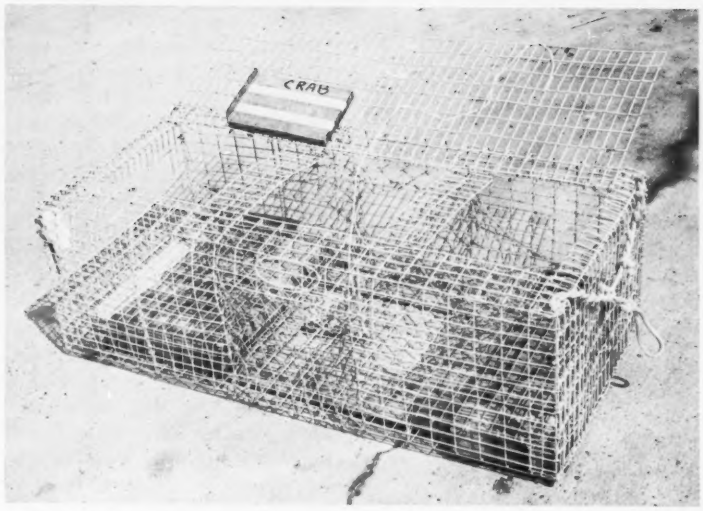

Figure 2.—Small aluminized wire lobster trap (48 x 22 x 14 inches) ballasted with bricks. Note central position of kitchen. The measuring board resting on the lid is 10 inches long.

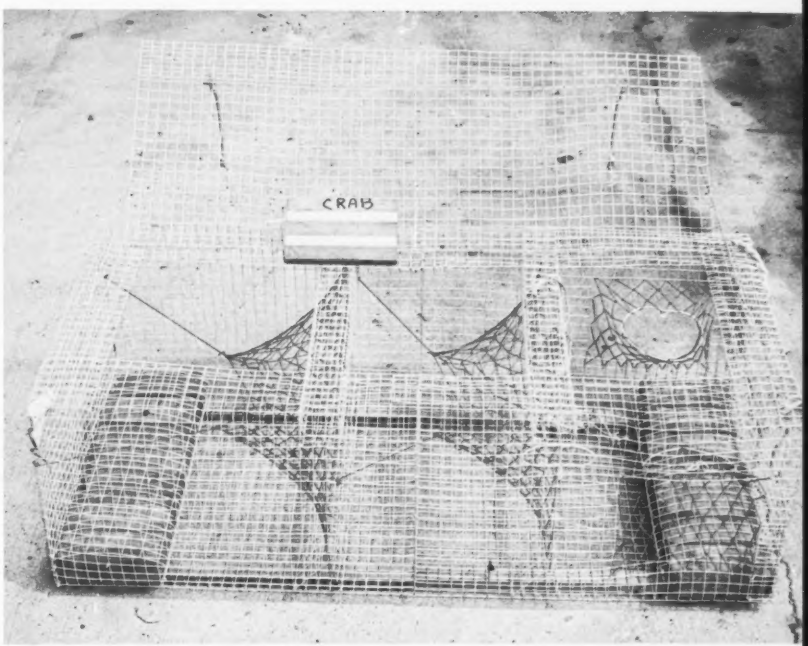

Figure 3.—Large aluminized wire lobster trap (60 x 30 x 18 inches) ballasted with bricks. Note the terminal position of the bait chamber (kitchen). The measuring board resting on the lid is 10 inches long.

INTERMOLT STAGE

All of the crabs caught in the traps were in the hard shell condition; no peeler or papershell specimens were observed. Most of the crabs taken in the trawl fishery were also in the hard shell stage, but a few peeler as well as soft and papershell stage crabs were also observed, indicating that some molting does occur in June.

QUALITY

There was a marked difference in condition of the crabs caught with the two types of gear. Those taken in the trawls were relatively inactive and required extensive washing to be rid of the mud which often filled the cod end of the net. Crabs in the traps were clean, and very active.

The larger crabs were steamed and eaten. The meat was easily picked and was rated very good to excellent in taste by nearly everyone on board the research vessel. The crabs were prepared as follows: the carapace was lifted off the fresh crab, the viscera and gills washed out and the mouth parts and abdominal apron removed. The body of the crab was then split in half lengthwise (an easy task). This method reduced the volume of material that had to be placed in the cooker and, subsequently, in freezer storage. Furthermore, the potential for bacterial growth and/or flavor deterioration of the meat was reduced by removing the internal organs. The frozen picked meat as well as the meat from frozen crab parts was also judged excellent in taste after at least three weeks in frozen storage.

DISCUSSION

Earlier exploratory studies reported the best fishing for red crabs to be between 200 and 300 fathoms (McRae, 1961; *Delaware II* Cruise Report 70-8). The most productive depth range encountered during trawling on the *Columbus Iselin* cruise was similar, i.e., 145-280 fathoms.

Based on the catch per trawl, it would appear that red crabs were more abundant on the slope than in the adjacent canyon. The trap catch records, however, strongly suggest that red crabs are available and vulnerable to traps at much greater depths, i.e., to 640 fathoms, at least in the canyon. Unfortunately, there was insufficient ship time to set and haul traps on the adjacent slope to compare the two areas.

Deep-sea trawling is very time consuming, a disadvantage that may limit or prevent its use as an economical means of harvesting red crabs. One must consider not only the time the trawl is fishing the bottom, but also the time required to set the net at the desired depth and to retrieve it. Furthermore, trawl-caught crabs are in relatively poor condition, particularly if the haul is loaded with mud. This, of course, was our experience with trawls lined with ½-inch mesh. Commercial gear equipped with larger mesh would probably not accumulate mud to the extent of a lined trawl, but the quality of the crabs might still present a problem if they are to be transported alive to shore facilities for processing. Shipboard processing would eliminate the problem because there is no difference in quality of the meat of trawl- and trap-caught crabs.

An efficiently handled trap fishery as presently conducted by several offshore lobster operations may be the most productive fishery investment. Since jonah crabs and lobsters are not abundant at the depths where red crabs are most abundant, fishermen could set pots at those depths which would provide the greatest economic return. Such a broad-based fishery would avoid the danger of seasonal changes in availability of any one species and would allow profitable use of vessels and gear year-round. Pots can be used on rough bottom where lobsters often congregate but are unavailable to a trawl. (This particular advantage of pot over trawl does not appear to apply to the red crab which prefers mud bottoms.)

Past experience on RV *Eastward* suggests that mortality is often high when red crabs are refrigerated in air or water and that larger crabs die first. Packing in ice may, as mentioned by Wilder (1966), be a solution, but onboard processing would seem to be a better method of handling red crabs, caught either by trap or trawl.

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Seven New Appointees Named to Marine Fisheries Advisory Committee

The appointment of seven men to the Department of Commerce's top level Marine Fisheries Advisory Committee has been announced by Secretary of Commerce Frederick B. Dent. The Committee advises the Secretary on programs carried out by the National Oceanic and Atmospheric Administration.

Topics of concern to the Committee include international fisheries, conservation, aquaculture, biological and environmental research, fisheries technology, certain sections of the Marine Mammal Protection Act of 1972, and advisory services for sport and commercial fisheries.

Members of the Committee are chosen for recognized competence and proven interest in the marine fishery resources of the United States, and are appointed by the Secretary for a term of one year, starting July 1, and are eligible for additional terms, for purposes of continuity. Committee members are also selected to achieve both balanced geographical representation as well as a broad view of the U.S. commercial fishing industry, marine sport fishing, the academic community, conservation interests, State governments, and the consumer.

The new members are:

Lawrence W. Appelbaum, Northfield, Ill., vice president of Penguin Frozen Foods and importer and exporter of fishery products, especially shrimp. He is also very active in the National Fisheries Institute, a private trade organization with nationwide membership.

Frank L. (Larry) Cassidy, Jr., Vancouver, Wash. Mr. Cassidy is sole stockholder of Son Sales, Ltd., manufacturers representative and broker in plumbing supplies in Oregon, Washington, and Western Canada. He served as president of Northwest Steelheaders, which has since merged with Trout Unlimited. He serves as national vice president and Executive Committee member of the latter organization which is concerned primarily with sport fishing.

John W. McKean, Portland, Oreg. Mr. McKean has been director of the Oregon Game Commission since 1969. Prior to that he was a game biologist with the Oregon Game Commission. He is active in the Pacific Marine Fisheries Commission, and is highly regarded for his knowledge of the fisheries problems of the Northwest. Mr. McKean is also active in the Western Association of State Game and Fish Commissioners, and the International Association of Game, Fish and Conservation Commissioners.

Dr. Theodore B. Ford, Baton Rouge, La. Dr. Ford is assistant director, Office of Sea Grant Development, Louisiana State University. Previously he was chief of the Louisiana Wildlife and Fisheries Commission's Oyster, Water Bottoms and Seafood Division. Highly knowledgeable on fisheries problems in the Gulf of Mexico, he is widely known as a State administrator and as an advisor to the Gulf States Marine Fisheries Commission.

Charles A. Black, Burlingame, Calif. Mr. Black is president, Mardela Corporation of Burlingame and has conducted an extensive survey on aquaculture, followed by a workshop for the National Oceanic and Atmospheric Administration. He is a recognized authority on aquaculture and will add expertise in an area of increasing emphasis by the Committee.

Frank G. Goto, Honolulu, Hawaii. Mr. Goto has been general manager,

Shrimp Aquaculture Training

"On-the-job training" in shrimp aquaculture is attracting an increasing number of scientists from this country and abroad to the Commerce Department's National Oceanic and Atmospheric Administration's facility at Galveston, Texas. The program is another step in international cooperation on fisheries research, particularly with scientists from Latin American nations.

The Gulf Coastal Fisheries Center at Galveston, operated by NOAA's National Marine Fisheries Service, deals with the culture of shrimp native to the Gulf of Mexico. Specific areas of research include maturation, diseases, nutrition, and hatchery technology. The studies are under the supervision of Dr. Richard A. Neal.

Progress in shrimp aquaculture is being followed closely in many parts of the world. Last year the Galveston Center sponsored a series of lectures and laboratory sessions for a total of 18 scientists from nine Latin American countries. Three Brazilian scientists recently concluded a two-month training period at Galveston.

On August 1, three scientists from the Center for Scientific and Technological Research, Sonora, Mexico, began three- to six-month training sessions. The "on-the-job training" is not restricted to foreign scientists, as evidenced by the large number of U.S. scientists utilizing the expertise developed at the Galveston laboratory.

The number of requests for training has increased markedly during the past year. Foreign scientists interested in participating in this activity should direct their inquiries to Frederick Laney, Office of International Affairs, NOAA, Rockville, MD 20852.

United Fishing Agency, Ltd. since 1952. The concern acts as a wholesaler of fresh fish and an agent for several tuna vessels. He serves on the Governor's Advisory Committees on Science and Technology, on Sharks, and on Labor and Industrial Relations. He is also executive secretary of Hawaii's Fish Boat Owner's Association.

Dr. James W. Burks, M.D., New Orleans, La. Dr. Burks is a Professor of Medicine at Tulane University and a senior staff physician at Charity Hospital and Touro Infirmary in New Orleans. He owns two fishing Corporations (Riptide, Inc., and Holliday Charters) and has extensive experience in charter boat sport fishing especially for big game fish species, as well as five years of commercial fishing business experience.

Members who have been reappointed for another one-year term are: **Theodore T. Bugas,** Astoria, Oreg., director of public and government relations for Bumble Bee Seafoods, Division of Castle Cooke, Inc.; **Charles R. Carry,** Redondo Beach, Calif., executive director of the Tuna Research Foundation, and a leading spokesman for the tuna canning industry and the California wetfish industry; **Dr. James A. Crutchfield, Jr.,** Seattle, Wash., associate professor of economics, University of Washington, Seattle and an internationally recognized authority on fisheries economics; **Jacob J. Dykstra,** Wakefield, R.I., president of Point Judith Fisherman's Cooperative Association; and **Ray H. Full,** Vermilion, Ohio, president of the Kishman Fish Company, and a member of the Ohio Commercial Fisherman's Association.

Also reappointed were **William B. Hannum, Jr.,** Key West, Fla., an active conservationist, former publishing executive, and president and director of Sea Farms, Inc., Key West, Fla.; **Allen W. Haynie,** Baltimore, Md., president of Zapata-Haynie, Inc., a wholly owned subsidiary of Zapata Corporation of Texas; **John D. Isaacs, III,** Rancho Santa Fe, Calif., oceanographer and professor at Scripps Institution of Oceanography, La Jolla, Calif., and Director of the Institute of Marine Resources of the University of California; **Harold E. Lokken,** Seattle, Wash., manager of the Fishing Vessel Owners Association since 1924; **Henry Lyman,** Canton, Mass., publisher of *Salt Water Sportsman* since 1949, and a member of various fisheries advisory committees in the New England area for more than 20 years; **John Mehos,** Galveston, Tex., vice president of Liberty Corporations, Liberty Fish and Oyster Co., former FBI agent, and founder and past president of the Shrimp Association of the Americas; **Howard Nickerson,** New Bedford, Mass., executive director of the Seafood Dealers Association of New Bedford, and president of Atlantic Marine Service, Inc., a consulting firm; **William F. Rockwell, Jr.,** Boston, Mass., chairman and chief executive officer of North American Rockwell Corporation, and an ardent conservationist, hunter, and angler.

Others reappointed for one-year terms include **John J. Royal,** San Pedro, Calif., secretary-treasurer, Fishermen's Union for 13 years, and a member of the Los Angeles Board of Harbor Commissioners since 1969; **Richard H. Stroud,** Springfield, Va., executive vice president of the Sport Fishing Institute, and vice president of the Sport Fishery Research Foundation; **Robert M. Thorstenson,** Petersburg, Alaska, president, Petersburg Fisheries and Seward Fisheries, Seward, Alaska; **Dr. James A. Timmerman, Jr.,** of Charleston, S.C., Director of the South Carolina Marine Resources Division, and a former chairman of the department of biology at the Citadel; **Clifford V. Varin** of West Sayville, N.Y., president of the Fire Island Sea Clam Company, president-elect of the Shellfish Institute of America, and a member of the executive committee for the Gulf and Caribbean Fisheries Institute; and **William H. Witherspoon,** Corona del Mar, Calif., retired, a collaborator in scientific projects, who has personally carried out much of the marlin tagging program off Baja, California. He has been vice president of the International Gamefish Association for the past 20 years.

Ahlstrom Awarded Commerce Gold Medal

Elbert H. Ahlstrom, Senior Scientist with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, has received the Department of Commerce Gold Medal for his leadership in developing an entire scientific technology, described as oceanic fish stock assessment by means of systematic surveys of eggs and larvae. Fishery scientists call the process a possible answer to the need for additional food resources worldwide.

Ahlstrom

Secretary of Commerce Frederick B. Dent presented the award—the highest honor conferred by the Department—to Dr. Ahlstrom in a ceremony at Washington, D.C.

Dr. Ahlstrom, stationed at the NMFS Southwest Fisheries Center (La Jolla, Calif.) since 1954, was cited for developing into a precise science techniques used to survey the abundance and distribution patterns of young stages of marine fishes in the ocean. His work has led to a basic scientific understanding of the fishery resources off California, and of how they can be exploited and used with maximum efficiency. Because the methods he developed are adaptable to other areas throughout the world with a need to evaluate the potential of fishery resources, Dr. Ahlstrom's contribution has had an important international impact.

Born at Sharon, Pennsylvania, in 1910, Dr. Ahlstrom was graduated from Marietta College, Marietta, Ohio, with an A.B. degree in 1930,

an almost perfect scholastic record, and selection to Phi Beta Kappa. He earned his M.A. degree in 1933 and his Ph.D. in Zoology in 1934 from Ohio State University, Columbus, Ohio. Dr. Ahlstrom spent five summers at Ohio State's laboratory at Put-in-Bay, Ohio, working on freshwater plankton, and he produced a number of papers on the subject of rotifers (microscopic aquatic invertebrates), which have become standard references.

Dr. Ahlstrom has spent most of his career in government service. In 1939 he joined the Fish and Wildlife Service, Department of the Interior, as a junior biological aid at $1,440 per annum. He was subsequently given continuing progressive responsibilities in carrying out major programs, and in 1959 became director of the biological laboratory at La Jolla, Calif., where he is now a Senior Scientist, highest NMFS scientific recognition.

He was appointed Adjunct Professor of Oceanography of the University of California in 1968. An international expert on Pacific sardines, Dr. Ahlstrom began cooperative oceanic investigations with the Scripps Institution of Oceanography in 1940 and 1941, using the Institution's old sailing research vessel the *E. W. Scripps*. The work led to the establishment of the California Cooperative Oceanic Fisheries Investigations (CALCOFI), an organization that began as an effort on the part of State agencies and the Federal Government to inquire into the causes of the catastrophic decline of the Pacific sardine which at one time supported the largest commercial fishery in the United States.

Dr. Ahlstrom has published more than 60 scientific papers. In 1972 he shared with another author an award by the Wildlife Society for the outstanding fishery publication of 1971. He is a member of many international committees and groups and has frequently served as an advisor and consultant to national and international groups.

Use of Silicone Grease and Dust Shields Improves Radio Communications at Sea

The Commerce Department's National Oceanic and Atmospheric Administration has found the solution to a problem which has hampered radio communications at sea during stormy weather since ships first began using wireless.

During heavy weather of long duration, salt spray and water often short-circuit the insulators of radio antennas to such a degree that ships cannot communicate with other ships or with stations ashore, creating an especially hazardous condition for vessels requiring aid.

The radio antennas used for transmitting and receiving messages by radio telephone and telegraph are isolated from the ship's steel structure by porcelain insulators located near the deck at the base of the antennas. As long as these insulators are clean and dry and have a high polish, they prevent the electrical current in the antennas from short-circuiting to the ship's steel hull. But when these insulators become covered with salt crystals from ocean spray and rain water from squalls, the electrical current is diverted to the steel hull. The antennas' radiated power is then diminished and, during prolonged storms, often terminated entirely, making radio transmission impossible.

This problem has now been solved by coating the porcelain insulators with a silicone grease to which water will not adhere. To protect the silicone grease from other contaminants, such as dust and particles from burned fuel oil, the grease is sheltered with a fiber glass shield shaped like an inverted funnel.

Two years of testing by three vessels of the NOAA Fleet—the *Mt Mitchell*, *Researcher*, and *Rainier*—proved the success of the new method, enabling the ships to continue radiocommunications practically unhampered during stormy weather.

The method was conceived and developed by William F. Seibold, Sr., a naval architect technician with NOAA's Office of Fleet Operations, with an expenditure in hardware of only $2,200. Seibold began experimenting with the silicone grease in 1970. A radio operator at sea for seven years, he subsequently served for nine years with the Maritime Administration's Engineering Division. For the past seven years he has been with the Coast and Geodetic Survey and its successor agency, NOAA's National Ocean Survey, which operates the NOAA Fleet.

The first tests of the new method began aboard the *Mt Mitchell* in 1970. For the test, insulators in one of the ship's antennas were coated with the silicone grease, while the other was left uncoated, to act as control. Subsequent testing aboard the *Mt Mitchell*, *Researcher*, and *Rainier* proved the method successful. The most recent test showed that during a voyage by the *Mt Mitchell* from the United States to France, the antenna continued to function well in severe weather, with rain squalls, high winds, and heavy spray. The *Researcher* has been using the new method also for over a year with perfect results. Seibold said the manufacturer of the silicone grease estimated one good coating should last a year, and it did.

Seibold anticipated that the new development will lead to further improvements in ship antennas and that, in the future, ships of all maritime nations will have antennas which will operate successfully with their radio equipment regardless of severe weather.

The new development may also provide a boon to radio and television broadcasting. Seibold said the same technique used on ships is also applicable to the antennas of radio and television broadcasting stations to prevent accumulations of ice and snow on their insulators.

Seized Japanese Vessel Hit by Suspension

In October, the Japanese Fisheries Agency gave a 100-day fishing suspension to the owner of the trawler *Mitsu Maru No. 30* (350 GT) seized by the U.S. Coast Guard on September 16, 1973 for illegal fishing operations off the Aleutian Islands, according to a report in the Japanese publication, "Shin Suisan Shimbun Sokuho," summarized by James H. Shohara of NMFS.

The 100-day suspension is considered as a heavy penalty in Japan since the owner not only has to keep his vessel idle but must continue paying wages to the crew members in order not to lose them. Three salmon vessels were subjected to similar penalties earlier in 1973 for violations of the international agreement subscribed to by Japan.

The owner of *Mitsu Maru* appealed for consideration of extenuating circumstances. The Agency, however, expressed the hope that the suspension would help restore Japan's international trust and ensure orderly fishing operations.

Earlier the *Mitsu Maru* was released by the United States after payment of fines totaling $230,000 ($30,000 master and $200,000 ship fines). The vessel's fish catch reportedly was also confiscated. Since the *Mitsu Maru* was not insured against seizures, its owner made full payment of the fines.

New Zealand, Japan Go for Squid

New Zealand has, for several years, been after an alternative fishery and had hoped that the type of squid it had would be the edible variety prized by the Japanese. However, from research so far, New Zealand squid (*Nototodarus sloani sloani*) is of the "arrow" variety, only some of which is suitable for human consumption, and which brings a lower price than the "broad finned" variety, according to the Worldwide Information Services, Inc.

Some "broad finned" squid are in New Zealand waters inshore or in the North Island areas. More plentiful arrow squid is ideal, however, for tuna bait, and is used by Japanese longline fishermen. New Zealanders want to catch arrow squid in their own waters and compete against squid caught in New Zealand waters by Japanese and shipped to Japan or American Samoa for sale to tuna longliners (mostly South Korean and Taiwanese).

Research has, so far, found that arrow squid in New Zealand waters breed over a longer period than in Japan, a point which is important when one remembers that the financial reward is greater if the size is right. Japanese say that the ideal size for arrow squid is 20 centimeters (8 inches) and up to 250 grams (9 ounces).

Squid in the 6-7 ounce range, packed 17.6 pounds to the case, with about 40 pieces to the case, command the best price. For this squid caught in Japanese waters, recent prices were: $5.65 to $6.00 per case for the 6-ounce squid; squid above 7 ounces packed in the same way (17.6 pounds/case) were averaging $3.75 to $4.50; smaller than 6 ounces were bringing $2.65 and over 10 ounces were bringing up to $5.65.

Japanese maintain that squid caught in New Zealand waters is of a "cheaper" variety than that which is required for human consumption in Japan. There are, however, from 40 to 50 ways in which squid can be prepared for human consumption.

While New Zealand was considering expansion of squid fishing in its inshore waters, the Japanese have expanded their operations offshore.

The Japanese Fisheries Agency, which in late August 1973 established a government approval system for squid fishing off New Zealand, on September 11 announced the vessel licensing policy for that fishery, according to an article from "Suisan Tsushin" summarized by James H. Shohara, NMFS.

Under the new policy, only large squid vessels (over 100 GT in size) approved by the government for distant-water fishing as of September 30, 1973, and survey vessels chartered by the semi-government Marine Fisheries Resource Research Center, will be permitted to engage in squid fishing off New Zealand. Vessels likely to qualify for that fishery are estimated to number around 140, almost doubling the fleet size which operated off New Zealand in 1972.

Concern was expressed among some Japanese that employment of such a large fleet might disrupt orderly operations, but the Fisheries Agency claims that, besides the grounds worked off New Zealand last year, there are other areas in that region which can be developed for squid fishing.

Japanese Seek Funds for Pollution Studies

The Japanese Agriculture and Forestry Ministry is seeking increased fund allocations for studies to protect the environment for the agricultural and fishery industries, says a report in "Suisan Keizai Shimbun" summarized by James H. Shohara, NMFS.

The Ministry's Agriculture, Forestry and Fishery Technical Council, which in fiscal year 1973 (April 1973-March 1974) began conducting technological studies for environmental effects of chemical and thermal discharges into the sea, plans to expand the research in FY 1974.

This year's mercury in tuna study, which includes tracing the course of concentration in the fish, will be expanded in FY 1974 to the investigation

of antagonistic agents in the tuna, such as selenium which recently has been found to counteract the toxicity of mercury. For this program, the Council is seeking a two-fold increase in budget for FY1974, to 24 million yen (approx. US$91,000).

Norwegians Campaign to Promote Greater U.S. Sardine Sales

A campaign to promote Norwegian canned sardines in the U.S. is in its fourth year. The campaign is funded by the Norwegian canning industry and conducted in cooperation with a San Francisco, Calif. advertising agency, according to Worldwide Information Services, Inc.

The head of the campaign in Norway recently was quoted as saying, "We have worked out a complete plan combining public relations (PR) drives, as well as advertising and sales promotion in shops and supermarkets. On the PR side we will stress the importance of getting recipes for sardine dishes printed in newspapers, weekly and women's magazines with circulations running into millions. Around 200 TV stations have already shown 'Norway Sardine' dishes in connection with their housewife programs. The same is the case with radio stations all over the U.S. Results so far, are much better than we had expected. The first year our main intention was to slow down the tendency of decreasing canned sardine sales. We did that and even more. We are now on the offensive and trying to reach new groups of potential buyers."

Japan to Export Tuna Fishing Vessels

The Japanese Ministry of International Trade and Industry has received, as of September 30, 1973, export license applications for sale to Panama of 22 new tuna longliners planned for construction from late 1973 to October 1974, according to an article in "Suisan Keizai Shimbun" summarized by James H. Shohara, NMFS.

These vessels, to be exported by several major Japanese trading firms (including Mitsubishi, Marubeni Iida and C. Itoh & Company), range in size from 300 to 450 GT and will be equipped with efficient freezing machines.

The export of this number of vessels is within the legal limits of the government's recently revised vessel export regulations allowing, in the case of tuna vessels, semi-annual sales of 25 vessels to one country or not more than 100 for all countries combined. However, since the longliners for Panama reportedly will be manned by low-paid South Koreans and operated under the so-called "flag of convenience," the Japanese tuna fishing industry is concerned that exports of new vessels with efficient freezing equipment will result in heavy shipments of frozen tuna to Japan for the "sashimi" (sliced fish eaten raw) market, thereby adversely affecting the Japanese fishermen.

Danish Landings Up Slightly: Prices Soar

Danish landings of fish, shellfish, and mollusks in the first six months of 1973 were 1.7 billion pounds, 3 percent more than for the comparable period in 1972, according to Worldwide Information Services, Inc. (see accompanying table).

Value of the landings, however, soared 60 percent. Although cod landings decreased 7 percent, the value of the catch was $31.7 million, an increase of 48 percent. Cod accounts for about one-third of the total Danish landings.

Sole landings were up 50 percent, prices 113 percent.

Herring landings tripled, as did prices. The only decreases were in salmon, which fell to less than half in quantity, and 28 percent less in price, and deep sea shrimp, where the catch decreased drastically and the total value 63 percent.

Danish landings, January-June, 1972 and 1973.

Species	1972		1973	
	Million pounds	Million dollars	Million pounds	Million dollars
Cod	213.4	21.3	198.0	31.7
Sole	1.3	0.9	2.0	2.8
Flounder	3.7	0.3	3.3	0.4
Plaice	47.3	7.6	40.3	11.3
Herring	35.9	2.9	104.0	12.5
Salmon	1.1	1.6	0.4	1.1
Deep sea lobster	2.0	1.4	1.2	1.4
Deep sea shrimp	5.3	1.8	1.2	0.7
Other	1,307.0	28.2	1,330.3	43.9
Total	1,617.0	66.0	1,680.8	105.8

West Germany Wants More Icelandic Fish

Representatives of Trawler Owners in the Federal Republic of Germany and other parts of the fishing and fish processing industry, met their Icelandic counterparts for discussions in Reykjavik in October. The Germans wanted to import more fresh Icelandic fish on ice. Iceland agreed to try to export 20 thousand tons of fresh fish annually, as well as some frozen, salted, and dried fish to the Federal Republic for the next two years. This will mean a considerable increase in the export of Icelandic fish to Germany as the annual quantity has been in the neighborhood of 12 thousand tons.

The German delegation promised to do its best to lower the landing costs of Icelandic vessels in German ports, which have always been considerably higher than for German vessels.

At the same time, the German delegation promised to do what it could to make the agreement between Iceland and the EEC concerning the removal of import duty on Icelandic fish products fully effective.

South African Hake Sales Increase

The Capetown Trawler Company Irvin and Johnson, is exporting considerable quantities of quick-frozen small hake to the United States and Australia. Hake is the basic fish caught on both sides of the South Atlantic.

However, with the rising cost of meat in South Africa, sales of hake within the country are increasing, according to Worldwide Information Services, Inc. This may reduce the amount of hake available for export.

Abundant hake was caught along the South African west coast in early October 1973. A fishery industry spokesman said that whole hake is bringing an ex-vessel price in Capetown of approximately US$0.31 per pound.

USSR Aids in Peru Fisheries Complex

On August 20, 1973, the Peruvian Ministry of Fisheries ratified a contract with the Soviet import-export enterprise "Prommashexport" for the construction of the Paita Fisheries Complex. The full text of the contract appeared in the Peruvian daily *El Peruano* of August 23, 1973, and was translated for the National Marine Fisheries Service. The contract specifies in great detail the services to be performed by the Soviets including preparation of plans for the construction of harbor facilities; supply the required equipment, machinery and material; and provide specialists for supervising the work and for helping install and assemble the equipment. All the construction work will be done by Peruvian firms. The Peruvians will pay the Soviets about 2,300,000 US dollars for services rendered. The translation (22 pp.) is available on loan from the Translation Program, International Activities Staff, Fx41, NMFS, NOAA, U.S. Department of Commerce, Washington, DC 20235.

Japan Imports More from Mainland China

Japanese imports of fresh and frozen fishery products from the People's Republic of China during January-August 1973 totaled 14,613 metric tons valued at 8,898.6 million yen (approximately US$33.8 million) on a customs clearance basis, according to an article in the "Suisan Tsushin" summarized by James H. Shohara, NMFS.

This is an increase of about 11 percent in quantity and 33 percent in value over comparable 1972 imports. The leading imports were fresh and frozen shrimp, which totaled 2,647 metric tons worth 3,407.9 million yen ($12,958,000), and salted herring roe, which recorded 1,595 metric tons worth 3,347.8 million yen ($12,729,000).

French Seek Live Eels

The Sarl Sete Maree firm is interested in purchasing large quantities of live eels, according to the U.S. Embassy, Paris. The firm imports fresh and frozen fishery products, and sells them to France, as well as other European countries. Interested parties should contact Mr. Fred Domeraji, Manager, Sarl Sete Maree, 81 Grand Rue Mario Roustand 34200 Sete, France.

Fishery Notes

South Carolina Plans Research Buildings

The South Carolina Wildlife and Marine Resources Department has announced plans to construct several new buildings at its Fort Johnson Marine Science Center. Cost of the new construction will amount to about $3.9 million and funds will be sought from the State, the Coastal Plains Regional Commission, and through a bond issue.

One of the buildings is a 30,000 square foot cooperative research facility to be added to the present Marine Research Laboratory building.

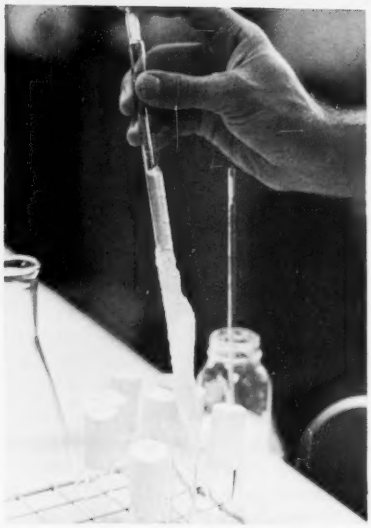
Plans are also underway for the construction of a new $2.2 million Seafood Technology Center to be used by the National Marine Fisheries Service of the U.S. Department of Commerce. The NMFS Fishery Products Technology Center is currently located in College Park, Maryland, but the staff is scheduled to move to Fort Johnson upon completion of the new building in late 1975. The laboratory will be owned by the State of South Carolina and will be leased on a long term basis by the Department of Commerce.

Seafood Advisory Laboratory Founded

A Seafood Advisory Laboratory has been established at Texas A&M University through the efforts of Dr. Ranzell Nickelson, II, with support from the Texas A&M Sea Grant College Program and the Texas Agricultural Extension Service.

The facility provides routine quality control testing, particularly for small

Texas A&M University's Dr. Ranzell Nickelson II prepares samples of shrimp for routine quality control testing.



The Texas A&M University Seafood Advisory Laboratory is equipped to make a number of physical, chemical, and bacteriological tests.

operations that cannot afford to maintain their own laboratories. For the larger businesses, the new lab serves as a reference facility to verify procedures and results.

Teaching is another important function of the laboratory, Nickelson says. Workshops are planned so that quality control and bacteriology laboratory personnel can learn new techniques and meet face-to-face with their colleagues and with researchers.

Nickelson, a seafood technology specialist, hopes to open the sophisticated laboratory to all personnel involved in the Texas seafood industry to demonstrate the reasons for rules and regulations on sanitation.

Publications

Cover-to-Cover Translations Offered

The American Fisheries Society (AFS) has sponsored since 1968 the cover-to-cover translation of two Russian bimonthly (six issues per year) fishery journals, *Voprosy Ikhtiologii* (Problems of Ichthyology) and *Gidrobiologicheskii Zhurnal* (Hydrobiological Journal). To date, Vols. 8-11, 1968- 1971, and issues 1-5, Vol. 12, 1972, of *Voprosy* and Vols. 5-7, 1969-1971, and issues 1-4, Vol. 8, 1972, of *Gidrobiologicheskii* have been translated. They are available from AFS, 4th Floor Suite, 1319-18th Street, N.W., Washington, DC 20036, at the following rates:

Journal	*Yearly Subscription per Volume*	*Single or Back Issues*
Voprosy	$125.00	$20.00
Gidrobiologicheskii	100.00	18.00

As a special offer, new subscribers are allowed a 30% discount on single or back issues.

The cover-to-cover translation of the Russian bimonthly fishery and oceanography journal *Okeanologiia* (Oceanology) has been sponsored since 1965 by the American Geophysical Union (AGU). Vols. 5-12, 1965-1972, have been translated to date and are available from AGU, 1707 L Street, N.W., Washington, DC 20036. Yearly subscriptions are $90.00 for Vol. 12 and single issues are $30.00 each. Back numbers are available at the following rates:

	Per Volume	*Single Issues*
Vol. 5 (1965) through Vol. 8 (1968)	$45.00	$ 8.50
Vol. 9 (1969)	60.00	12.50
Vol. 10 (1970) and Vol. 11 (1971)	75.00	30.00

"Fishing Business Management" Issued

Oregon State University Extension Service has issued a new publication entitled "Fishing Business Management." The bulletin was prepared to assist fishermen in understanding some of the terms and concepts of business management as they apply to fishing. There are no "short cuts" to better management, and the bulletin does not pretend to provide ready solutions to management problems.

Unfortunately, the terminology of business management is frequently confusing to the uninitiated. Businessmen, as well as fishermen, have their own "language." Although new (and sometimes confusing) terminology is minimized here, readers of the publication should be prepared to learn some new business management concepts.

To obtain the bulletin entitled "Fishing Business Management," contact Extension Service, Oregon State University, Corvallis, OR 97331.

Russian Fisheries Papers Translated

The following Russian publications were recently translated and printed in Israel for the National Marine Fisheries Service (NMFS), NOAA, under the Special Foreign Currency Science Information Program (financed with Public Law 480 funds). They are sold at the indicated prices by the National Technical Information Service, Springfield, VA 22151. When ordering, cite the translations' accession numbers.

1. **"Shark Flesh in the Food Industry,"** by V. S. Gordievskaya, Pacific Ocean Research Institute of Marine Fisheries and Oceanography (TINRO), Vladivostok, 1971, 26 pp. The volume deals with the food value of sharks and the technological characteristics and culinary utilization of shark meat. The species covered include mostly sharks of the Pacific Ocean. Discussed in detail are the size-weight and technochemical properties of sharks; removal of urea; and the preparation of preserved, smoked and cured products, sausages, and fins. The translation includes a list of common and scientific names of sharks appearing in the text. TT 72-50020, $3.00.

2. **"Mass Cultivation of Invertebrates. Biology and Methods,"** by I. V. Ivleva, Academy of Sciences of the U.S.S.R., "Nauka" Publishers, Moscow, 1969, 148 pp. The book deals with the biology and cultivation of some invertebrate species which are reared on a mass scale in the USSR: soil Oligochaeta; free-living nematodes;

phyllopod crustaceans; Daphnidae; and chironomid larvae. The biology of the species is characterized and a brief outline of their gross morphology is given. Also discussed are: distribution and relation to environmental factors; reproduction, growth, and development; population growth; feeding; chemical composition of bodies; and respiration. The description of culturing methods includes the initial and peak density of the culture, rearing periods, maintenance of optimal conditions, manipulations of the culture, feeds and feeding regime, and output. Methods for the maintenance of animal groups in the laboratory are given in some cases. TT 72-50055, $4.75.

3. **"Echolocation in Animals,"** by E. Sh. Airapetyants and A. I. Konstantinov, Academy of Sciences of the USSR, "Nauka" Publishers, Leningrad, 1970, 309 pp. The book gives information on various little known aspects of the echolocating animals and traces the patch of man's discovery of their specialized means of spatial analysis. Described in detail are the parameters of acoustic orientation signals, the mechanisms of their emission, and the reception and analysis of sound reflected from objects. An appraisal is made of the possibilities of echolocation, with particular emphasis on bats and dolphins. A survey of echolocation in marine animals includes also baleen whales, Cetacea in general, and Pinnipedia. TT 72-50012, $7.00.

4. **"Disease of Pond Fishes,"** by O. N. Bauer, V. A. Musselius, and Yu.A. Strelkov, "Kolos" Publishers, Moscow, 1969, 220 pp. Deals with the major infections, parasitic and noncommunicable diseases of pond fishes. It answers questions on the causes of diseases and on measures for their prevention, treatment, and control through therapeutic and biological methods. In addition to the diseases of common species such as carp and trout, disease of fish imported for pond culture, mainly plant-feeding species and whitefish, are also described. TT 72-50070, $5.75.

Polish Journals Are Translated

The translation and printing of selected articles from the Polish journal *Technika i Gospodarka Morska* (Marine Technology and Management) are being done in Poland for the National Science Foundation under the Special Foreign Science Information Program (financed with Public Law 480 funds). The translations are sold for $3.00 each by the National Technical Information Service (NTIS), Springfield, VA 22151. Selections from one or two issues are included under one cover and the latest ones to be published are from Vol. 20, 1970: Nos. 5-6 as TT 70-55125/5,6, and No. 7 as TT 70-55125/7. When ordering, cite the translations' accession numbers.

Articles on fisheries in those issues include: utilization of costs calculation as an instrument for decision making in the fishing industry; Barents Sea fishery resources and their exploitation; level of working time utilization by deep-sea fishing craft; reconnaissance craft and provision of electric equipment for fishing craft; question of regulating prices of fish and fishery products; transporting fish in East Germany and Poland; problems of preventing marine pollution; comparison of input and output in livestock production and marine fisheries; international market for frozen fishery products; Polish Sea Fishing Zone and contemporary international practice; and problems of Turkish fisheries.

The translation and printing of selected articles from the Polish journal *Budownictwo Okretowe* (Shipbuilding) are also being done in Poland for the National Science Foundation under the Special Foreign Science Information Program (financed with Public Law 480 funds). The translations are sold for $3.00 each by the National Technical Information Service (NTIS), Springfield, VA 22151. Selections from two issues are included under one cover and the issues published so far are from Vol. 15, 1970; Nos. 1-2 as TT 70-55126/1,2, Nos. 3-4 as TT 70-55126/3,4, Nos. 5-6 as TT 70-55126/5,6, Nos. 7-8 as TT 70-55126/7,8, and Nos. 9-10 as TT 70-55126/9,10. When ordering, cite the translations' accession numbers. Articles on fisheries in those issues include: fishing fleet of Cyprus; power rating analysis of propulsion engines for fishing vessels; power plants for small fishing vessels; freezer trawler LASKARA type B-29; 1969 vessels output of East Germany: tonnage and structure; purse seiners, development trends and conclusions; and freezer trawlers type B-427.

Economic Data Available

The Economic Research Division of the National Marine Fisheries Service has recently published "**Basic Economic Indicators**" covering many of the major fisheries of the United States. The publications bring together diverse data on the main species of fish landed and marketed in the United States. The data range from earnings and productivity of fishermen, value of fishing vessels, and socioeconomic characteristics of fish consumers, to biological assessment, foreign production and trade barriers. The range and breadth of data on a species basis make it possible to pursue research much more easily and to gain a general knowledge of developments in the Nation's fisheries.

Publications presently available are:

Menhaden, 1946-72	CFS No. 5934	June 1973
Scallops, 1930-72	CFS No. 6127	June 1973
Halibut, 1929-72	CFS No. 6128	June 1973
Salmon, 1947-72	CFS No. 6129	Aug. 1973
Tuna, 1949-72	CFS No. 6130	June 1973
Shrimp, 1949-72	CFS No. 6131	June 1973
Blue Crab, 1947-72	CFS No. 6132	Sept. 1973
King and Dungeness Crabs, 1947-72	CFS No. 6133	August 1973

Similar publications for groundfish, lobsters, clams and oysters are forthcoming.

Single copies can be obtained from:
Technical Information Division, D83
Environmental Science Information Center, NOAA
U.S. Department of Commerce
Washington, DC 20235

Recent NMFS Scientific Publications

NOAA Technical Report NMFS SSRF-666, Turner, William R., and George N. Johnson, **"Distribution and relative abundance of fishes in Newport River, North Carolina,"** September 1973, iv + 23 p. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. Price: 35 cents.

ABSTRACT

Monthly sampling in Newport River during 1970 disclosed a total of 104 species of fishes within the system. Sampling extended from the lower reaches of the estuary upstream into tidal fresh waters, and covered a mid-channel distance of 34.87 km. To sample as wide a range of species as possible, an array of collecting gear was used, i.e., haul seine, surface trawl, bottom trawls (two sizes), and gill nets. In terms of catch per unit of effort, the surface trawl was the most successful gear employed, whereas gill nets, the least efficient gear, captured the greatest variety of species.

Most of the species of fishes collected in the system were marine forms. Only 15 essentially freshwater species were collected and 5 of these (longnose gar, gizzard shad, golden shiner, white catfish, and black crappie) showed varying degrees of tolerance for saline waters (0.6-33.7 percent).

Relative numbers of fishes in collections by the different gears indicated that seven species made up 97 percent of the total catch which comprised nearly 129,000 individuals. The dominant species were all marine euryhaline forms that used the estuary as a nursery area, penetrating well upstream into brackish or even tidal fresh waters. Seasonal distribution and abundance of the dominant species, as well as other species collected in substantial numbers, are discussed.

Biomass of fishes in collections by haul seine was estimated at 0.93 g/m^2 for littoral waters of the estuary. Samples collected by other gears did not yield satisfactory estimates of biomass.

NOAA Technical Report NMFS SSRF-667, Thomas, James C., **"An analysis of the commercial lobster (*Homarus americanus*) fishery along the coast of Maine, August 1966 through December 1970,"** June 1973, v+ 57 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Price: 65 cents.

ABSTRACT

We have used some life history information and detailed catch and effort data from probability sampling of the commercial catch of lobsters to estimate a biological minimum size of 89-mm (3½ inches) carapace length for maximum sustainable yield. In view of this recommendation, the maximum size regulation of 127-mm (5 inches) carapace length is unnecessary.

NOAA Technical Report NMFS CIRC-375, Day, John H., **"New polychaeta from Beaufort, with a key to all species recorded from North Carolina,"** July 1973, xiii + 140 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Price: $1.25.

ABSTRACT

Over 6,000 polychaete worms belonging to 229 species were collected on a transect running from the sandy shore near Beaufort, N.C., to the upper part of the continental slope in 200 m. Eleven more species were collected from the shores of Beaufort Sound and from grab samples in 400, 600, and 3,020 m off North Carolina. The whole collection includes 19 new species, 2 new subspecies, and 16 new records for the United States. These have been described. An examination of the literature revealed that a further 83 species had been recorded by earlier workers so that a total of 323 species of polychaete worms are now known from North Carolina. Keys have been constructed to cover the whole fauna, all original records have been listed, and references to good descriptions of each species are given. During the course of the work several type specimens were examined and this has resulted in certain changes in nomenclature and the redefinition of certain genera in the families Orbiniidae, Flabelligeridae, and Ampharetidae.

NOAA Technical Report NMFS CIRC-386, McCloskey, Lawrence R., **"Marine flora and fauna of the northeastern United States. Pycnogonida,"** September 1973, iii + 12 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Price: 30 cents.

ABSTRACT

The manual includes an introduction on the general biology, an illustrated key, an annotated systematic list, a selected bibliography, and an index to the Pycnogonida along the coast of the United States from Maine to New Jersey out to 100 m.

NOAA Technical Memorandum NMFS ABFL-1, Bailey, Jack E., and William R. Heard, **"An improved incubator for salmonids and results of preliminary tests of its use,"** September 1973, iii + 7 p.

ABSTRACT

The environmental requirements of salmonid eggs and alevins are not fully met in conventional hatchery practices, and the resulting fry are physically and behaviorally different from those produced in nature. This report describes an incubator that simulates the natural environment while functioning under rigorous climatic conditions with minimal maintenance. Pink salmon fry, *Oncorhynchus gorbuscha*, reared in a laboratory test of this incubator emerged earlier than wild fry and were as heavy as wild fry. Midrun incubator-reared fry were shorter than late run wild fry, but the incubator-reared fry still had 0.6 to 0.9 mg of yolk, whereas the late run wild fry had none. Midrun incubator-reared fry were superior to early run wild fry in ability to resist starvation. A field test established that with little maintenance the incubator can produce fry during the spring and summer.

Ocean Perch Fillets Show August Gain, Groundfish Supplies Up

Supplies of fishery products in the United States became increasingly tight during August. Available supplies of fish blocks, cod fillets, spiny lobsters, and shrimp were well below the previous year. Furthermore, new supplies (landings plus imports) of flounder, haddock, and sea scallops were also down from 1972 during the month. Only ocean perch fillets registered a substantial gain during August. As a result, prices of most species rose during the month, with many reaching record levels.

GROUNDFISH

Supplies of the major groundfish fillets during August (Tables 1-5) were 29 percent above the previous year as large beginning-of-the-month holdings and a slight gain in imports compensated for a 34 percent drop in the domestic catch. Landings of all the major species (cod, flounder, haddock, and ocean perch) continue to be well below 1972.

Although new supplies during the month were below 1972, the quantity of groundfish in storage is sufficiently large to support a substantial gain in consumption. Despite price increases (Table 6) for all species at all levels, consumption during August rose 10 percent above the same month a year ago. Sales of ocean perch led the gain by rising 92 percent. Lower supplies and high prices, however, combined for a 30 percent drop in cod consumption.

BLOCKS, SLABS, STICKS, AND PORTIONS

Raw material for fish sticks and portions production continued to be short in August as imports of blocks (Table 7) were again below the previous year. The quantity received during August, however, was well above the amount imported in July. In an apparent effort to build supplies in anticipation of heavy fourth quarter production, inventories rose 32 percent during the month. However, this large increase was about a million pounds short of the August, 1972 inventory build up. Prices of blocks (Table 8) responded to the growing shortage by increasing from 2 to 3 cents for most species. The steady increase in block prices so far in 1973 can only spell further price increases for sticks and portions (Tables 9-10) in later months. Further upward pressure on prices will also come from a projected reduction in stick and portion production during the fourth quarter. Although inventories of sticks and portions in August were above the previous year, the increase was not sufficiently large to compensate for the shortage expected later.

SHRIMP SUPPLIES DOWN

Supplies of shrimp (Table 11) during August were again well below the previous year—down 46 percent from the same month in 1972. The supply situation in the shrimp industry continued to worsen during the month.

Table 1.—Groundfish supplies (fillet weight in million pounds) in August 1973. Groundfish include cod, flounder, haddock, and ocean perch.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	34.5	42.6	47.5	27.0	+76	52.4	45.0	+16
Landings, Total	6.7	4.6	4.2	6.4	−34	42.1	47.3	−11
Imports	33.9	25.9	32.1	31.6	+ 1	206.2	177.6	+16
Total Supply	75.1	73.1	83.8	65.0	+29	300.7	269.9	+11
Ending Inventory	42.6	47.5	49.1	33.5	+47	49.1	33.5	+47
Consumption	32.5	25.6	34.7	31.5	+10	251.6	236.4	+ 6

Table 2.—Cod supplies (fillet weight in million pounds) in August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	14.7	15.7	14.7	13.7	+ 7	16.2	6.1	+166
Landings, Total	1.5	1.0	1.0	1.2	−17	9.5	9.6	− 1
Imports	9.4	5.8	7.5	10.9	−31	62.0	74.7	− 17
Total Supply	25.6	22.5	23.2	25.8	−10	87.7	90.4	− 3
Ending Inventory	15.7	14.7	15.5	14.8	+ 5	15.5	14.8	+ 5
Consumption	9.9	7.8	7.7	11.0	−30	72.2	75.6	− 4

Table 3.—Flounder supplies (fillet weight in million pounds) in August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	6.0	8.4	9.6	3.5	+174	8.6	9.3	− 8
Landings, Total	2.9	2.1	1.9	3.1	− 39	18.3	20.5	− 11
Imports	11.0	6.6	8.8	8.8	—	62.5	43.8	+ 43
Total Supply	19.9	17.1	20.3	15.4	+ 32	89.4	73.6	+ 21
Ending Inventory	8.4	9.6	9.6	4.7	+104	9.6	4.7	+104
Consumption	11.5	7.5	10.7	10.7	—	79.8	68.9	+ 16

Landings and imports were well below a year ago, as were inventories on September 1.

U.S. landings dropped 41 percent during August, resulting in an 8-month total of 133 million pounds—14 percent below January-August 1972. Lower Gulf shrimp landings continue to be the primary reason for the 1973 decline. Apparently, the effects of the spring floods on the shrimp crop were still being felt in that area. Only the Pacific catch increased in 1973, based on higher landings in Alaska and a record catch in Oregon.

Although the quantity of imports improved from large earlier declines to only a 7 percent drop in August, the total amount received during the first 8 months was still off 16 percent from the previous year. One encouraging note during the month, however, was a 28 percent rise in the quantity imported from India (the second leading source of U.S. shrimp imports). This is particularly noteworthy because of the 58 percent decline in shipments received from that country during the first 7 months of 1973. The August increase from India is likely the result of reduced Japanese purchases of shrimp due to sluggish market conditions in Japan.

Although the supply of shrimp in the United States has become increasingly tight, exports of shrimp continue to be well above the previous year. While increased exports during the first 7 months were supported by higher shipments to Japan, the August increase was not. The gain during that month was the result of increased shipments to several European countries, including Denmark, Norway, Sweden, and the United Kingdom. One possible explanation for this gain is that domestic price increases are regulated under Phase IV controls while export prices are not. The opportunity for greater profits through exports has, therefore, apparently provided sufficient incentive for a substantial increase in fresh and frozen shrimp exports.

Table 4.—Haddock supplies (fillet weight in million pounds) in August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	8.3	8.3	8.8	3.5	+151	9.8	8.9	+10
Landings, Total	0.5	0.3	0.3	0.4	− 25	2.4	3.1	−24
Imports	4.0	3.3	4.3	4.3	—	28.9	21.5	+34
Total Supply	12.8	11.9	13.4	8.2	+ 63	41.1	33.5	+23
Ending Inventory	8.3	8.8	8.8	4.5	+ 96	8.8	4.5	+96
Consumption	4.5	3.1	4.6	3.7	+ 24	32.3	29.0	+11

Table 5.—Ocean perch supplies (fillet weight in million pounds) in August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	5.5	10.2	14.4	6.3	+129	17.8	20.7	−14
Landings, Total	1.8	1.2	1.0	1.7	− 41	11.9	14.1	−16
Imports	9.5	10.2	11.5	7.6	+ 51	52.8	37.6	+40
Total Supply	16.8	21.6	26.9	15.6	+ 72	82.5	72.4	+14
Ending Inventory	10.2	14.4	15.2	9.5	+ 60	15.2	9.5	+60
Consumption	6.6	7.2	11.7	6.1	+ 92	67.3	62.9	+ 7

Table 6.—Groundfish prices (wholesale, FOB Boston, Gloucester, and New Bedford), August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
Cod								
Ex-vessel[1]	14.3	18.9	20.1	18.0	+12	19.9	19.7	+ 1
Wholesale								
1 lb Canadian	66.1	68.1	71.8	56.5	+27	62.6	55.1	+14
5 lb Canadian	63.5	64.0	67.1	56.0	+20	58.3	54.4	+ 7
Retail[2]	170.6	170.0	179.3	124.0	+45	178.5	129.3	+38
Flounder								
Ex-vessel								
Yellowtail	15.78	19.90	24.47	14.30	+71	24.04	19.3	+24
Lemonsole	28.57	52.00	64.52	45.00	+43	45.91	39.29	+17
Greysole	19.17	29.17	32.44	22.83	+42	29.53	25.23	+17
Blackback	18.48	30.02	38.62	26.29	+47	28.77	27.80	+ 3
Wholesale								
5 lb domestic	85.6	87.5	[3]	88.8	[3]	[3]	88.7	[3]
5 lb Canadian	80.0	81.8	83.2	67.5	+23	80.1	59.9	+34
Retail[2]	216.6	219.4	231.6	170.0	+36	217.1	163.6	+33
Haddock								
Ex-vessel[1]								
Large	40.8	49.5	52.6	40.4	+30	46.6	41.2	+13
Scrod	21.3	22.9	25.5	28.2	−10	27.0	32.7	−17
Wholesale								
5 lb Canadian	79.9	83.7	83.0	76.5	+ 9	79.8	64.4	+24
Retail[4]	132.2	133.6	136.3	106.9	+28	126.4	104.1	+21
Ocean Perch								
Ex-vessel[1]	7.5	7.6	8.3	6.2	+34	7.5	5.5	+36
Wholesale								
5 lb domestic	59.3	58.0	63.8	52.0	+23	59.8	40.8	+47
5 lb Canadian	55.5	55.8	59.5	45.5	+31	54.5	39.6	+38
Retail[4]	99.6	99.8	100.7	77.1	+31	95.1	74.0	+29

[1] Quotes taken at Boston, Mass.
[2] New York Consumer Market Reports
[3] No quotes during August 1973
[4] Bureau of Labor Statistics (average of 36 U.S. cities).

Prices at all levels (Table 12) were well above the previous year, particularly for the smaller size shrimp. Because of the current shortage of supply, prices generally rose 10 to 20 percent above last month. This rapid price rise had little affect on consumption, however. Sales were up a hefty 52 percent during August, leaving January-August consumption of 266 million pounds 4 percent above the previous year.

SCALLOPS

Total supplies of scallops (Table 13) during August were again well above the previous year. Although total supplies were 23 percent above the quantity available during the same month in 1972, the August total was significantly below the 55 percent gain registered in July. High beginning-of-the-month inventories offset declines of 39 and 24 percent for landings and imports, respectively. The decline in landings was apparently caused by the tie-up of the New Bedford scallop fleet while lower imports were undoubtedly affected by the high quantity of scallops currently in storage.

Consumption of sea scallops dropped sharply during the month—down 28 percent from the previous year. August's decline was likely a continuing reaction to the record prices (Table 14) prevalent through July.

AMERICAN LOBSTER

The supply picture for American lobsters (Table 15) continues to be one of increasing landings and lower imports. Supplies during the month were up about 4 percent to 4.6 million pounds; however, the total amount available during the first 8 months of the year was down about 4 percent. The decline in the quantity imported has more than compensated for the rise in Maine landings.

Demand has apparently remained strong because prices rose sharply during the month (Table 16). Ex-vessel prices in August were up about 2 percent from July and 50 percent from 1972. Wholesale prices rose an average of 17 percent above July and 38 percent above the previous August.

SPINY LOBSTER

August recorded an increase in the quantity of spiny lobster imports for the first time in 1973 (Table 17). Although the January-August total is still down 16 percent, the quantity received in August was up 14 percent from the previous year. Higher shipments from Brazil, India, and Hong Kong were primarily responsible for the August increase. While receipts of warm-water tails have increased, poor catches in Australia and New Zealand, and local regulations on fishing and marketing in South Africa have limited shipments of cold-water tails. As a

Table 7.—Supplies of blocks and slabs, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	32.3	33.1	48.8	77.0	−37	75.8	62.7	+ 21
Production	[1]	[1]	0.5	[1]	—	3.3	1.3	+154
Imports	31.3	27.4	42.9	44.1	− 3	214.1	259.5	− 17
Total Supply	64.0	60.8	92.2	121.2	−24	293.2	323.5	− 9
Ending Inventory	33.1	48.8	64.5	93.8	−31	64.5	93.8	− 31
Consumption	30.9	12.0	27.7	27.4	+ 1	228.7	229.7	—

[1] Less than 500,000 pounds

Table 8.—Prices of blocks and slabs, August 1973 (wholesale prices of blocks FOB Boston, Mass.).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Cents Per Pound											
Cod	1972	46.5	47.0	47.0	47.0	45.6	46.5	47.0	47.0	47.0	47.0	47.0	48.0
	1973	48.6	52.4	56.6	58.5	61.1	66.7	68.9	71.9				
Flounder	1972	43.5	44.4	45.3	49.2	51.7	53.3	55.6	57.0	58.0	58.0	58.7	59.5
	1973	59.5	59.6	60.0	60.0	60.0	62.0	63.0	65.3				
Haddock	1972	47.1	47.5	47.5	47.9	50.3	52.8	54.4	57.0	58.1	59.5	59.5	59.5
	1973	60.2	60.5	61.4	63.3	64.9	69.0	73.3	75.5				
Ocean perch	1972	38.5	38.5	38.7	39.5	39.5	39.8	41.6	45.0	48.0	48.3	49.4	49.5
	1973	51.2	53.2	53.9	54.0	54.8	53.9	54.0	65.7				
Pollock	1972	32.3	32.0	32.0	32.1	31.2	31.5	31.5	31.0	29.6	29.5	28.3	28.0
	1973	29.0	30.1	33.0	34.0	35.2	39.8	43.1	46.0				
Whiting	1972	33.0	33.5	33.0	33.0	33.2	32.5	31.5	31.5	31.5	32.0	34.1	34.5
	1973	34.6	35.8	37.5	37.5	37.5	39.4	41.1	42.6				
Wolffish	1972	49.3	50.0	50.0	50.0	50.3	50.5	51.0	51.5	51.3	51.0	51.0	51.0
	1973	51.0	50.0	54.5	52.0	52.0	52.0	52.0	52.0				

Table 9.—Supplies of sticks and portions, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	27.5	31.6	28.2	21.7	+30	34.4	23.2	+48
Production								
Sticks	8.6	N.A.[1]	N.A.	8.5	—	N.A.	72.6	—
Portions	22.5	N.A.	N.A.	22.7	—	N.A.	170.6	—
Total	31.1	N.A.	N.A.	31.2	—	N.A.	243.2	—
Imports	0.2	0.1	0.1	0.2	−50	1.1	1.1	—
Total Supply	58.8	N.A.	N.A.	53.1	—	N.A.	267.5	—
Ending Inventory	31.6	28.2	26.8	21.6	+24	26.8	21.6	+24
Consumption	27.2	N.A.	N.A.	31.5	—	N.A.	245.9	—

[1] Some July and August data not yet available.

Table 10.—Weekly average wholesale prices of sticks and portions, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
				Cents Per Pound				
Cod portions	67.0	67.0	67.0	60.5	+11	65.4	59.0	+10
Haddock	69.5	72.0	72.0	65.0	+11	69.9	63.8	+10
Cod sticks	78.0	87.0	87.0	77.0	+13	80.3	75.3	+ 7
Haddock sticks	80.0	80.0	80.0	79.2	+ 1	80.0	77.5	+ 3

Table 11.—Shrimp supplies, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	54.2	51.6	51.5	69.2	−26	92.7	69.9	+ 33
Landings								
Total	23.0	20.0	14.6	24.9	−41	133.7	155.5	− 14
Gulf	17.5	14.5	9.7	19.9	−51	67.3	93.0	− 28
Northeast	1.0	0.6	0.5	0.6	−17	10.8	13.0	− 17
Pacific	2.8	3.3	2.5	2.1	+19	49.9	41.9	+ 19
South Atlantic	1.7	1.6	1.9	2.3	−17	5.7	7.6	− 25
Imports	15.4	17.0	18.6	20.0	− 7	135.9	162.7	− 16
Total Supply	92.6	88.6	84.7	114.1	−26	362.3	388.1	− 7
Ending Inventory	51.6	51.5	47.6	88.2	−46	47.6	88.2	− 46
Exports								
Total	4.5	3.1	3.3	2.0	+65	35.4	24.2	+ 46
Domestic Fresh & Frozen	2.7	2.7	2.9	1.6	+81	26.4	19.9	+ 33
Transshipments	1.8	0.4	0.4	0.4	0	9.0	4.3	+109
Gulf Canned Pack	8.0	2.2	0.6	2.1	−71	13.4	19.2	− 30
Fresh & Frozen Consumption	28.5	31.8	33.2	21.8	+52	265.9	256.5	+ 4

Table 13.—Scallop supplies, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Thousand Pounds				*Percent*	*Thousand Pounds*		*Percent*
Beginning Inventory	3,001	3,029	3,429	1,408	+144	3,736	1,585	+136
Landings, Total	578	700	450	738	− 39	4,573	4,623	− 1
Imports	1,638	1,780	2,002	2,621	− 24	13,380	12,184	+ 10
Total Supply	5,217	5,509	5,881	4,767	+ 23	21,689	18,392	+ 18
Ending Inventory	3,029	3,429	3,655	1,686	+117	3,655	1,686	+117
Consumption	2,188	2,080	2,226	3,081	− 28	18,034	16,706	+ 8

Table 15.—American lobster supplies, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Thousand Pounds				*Percent*	*Thousand Pounds*		*Percent*
Maine Landings	914	1,425	2,738	2,471	+11	7,405	6,145	+20
Imports	5,309	3,267	1,877	1,979	− 5	20,126	22,678	−11
Consumption	6,223	4,692	4,615	4,450	+ 4	27,531	28,823	− 4

Table 17.—Spiny lobster tails, supplies, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change	Jan-Aug 1973	Jan-Aug 1972	Percent change
	Million Pounds				*Percent*	*Million Pounds*		*Percent*
Beginning Inventory	6.9	7.5	6.7	8.0	−16	8.9	4.7	+89
Imports	2.9	2.0	2.5	2.2	+14	22.1	26.2	−16
Total Supply	9.8	9.5	9.2	10.2	−10	31.0	30.9	0
Ending Inventory	7.5	6.7	6.8	8.7	−22	6.8	8.7	−22
Consumption	2.3	2.8	2.4	1.5	+60	24.2	22.2	+ 9

result, imports from those countries have been about the same or below the previous year throughout most of 1973.

Consumption during the month was up 60 percent from the extremely low quantity consumed in August, 1972. This is particularly noteable in light of the record prices (Table 18) registered during the month. The wholesale price for cold-water tails stabilized during the month, however, the prices quoted for warm-water tails continued to rise.

Table 12.—Shrimp prices, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change
			Dollars Per Pound		
Ex-vessel					
15-20 count	2.12	2.24	2.51	1.92	+31
31-35	1.70	1.77	2.14	1.38	+55
51-65	1.30	1.42	1.66	.86	+93
Wholesale					
15-20 count	2.34	2.38	2.75	2.13	+29
31-35	2.06	1.98	2.31	1.59	+45
51-65	1.58	1.58	1.76	1.03	+71
Retail					
15-25 count	2.94	2.94	3.13	2.95	+ 6
31-42	2 38	2.49	2.73	2.09	+31

Table 14.—Scallop prices, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change
			Dollars Per Pound		
Ex-vessel	1.44	1.48	1.98	2.16	−8
Wholesale	1.64	1.63	—	2.34	—
Retail	3.03	2.80	2.51	2.74	−8

Table 16.—American lobster prices, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change
			Dollars Per Pound		
Ex-vessel	1.37	1.46	1.50	1.00	+50
Wholesale					
2 lb	1.97	2.16	2.81	2.08	+35
1½	1.96	2.16	2.78	2.08	+34
1¼	1.93	2.16	2.72	1.98	+37
1⅛	1.90	2.12	2.68	1.91	+40
chix	1.89	2.12	2.66	1.86	+43

Table 18.—Spiny lobster tail, wholesale prices, August 1973.

	June 1973	July 1973	Aug 1973	Aug 1972	Percent change
			Dollars Per Pound		
6-8 oz tail					
Cold-water	4.82	4.88	4.85	4.27	+14
Warm-water	3.82	4.00	4.21	3.64	+16

Editor's Comments

Charles H. Gilbert and the *Charles H. Gilbert*

The *Charles H. Gilbert*

• Charles H. Gilbert (1859-1928) was an American zoologist who became a member of the staff of the U.S. Fish Commission, predecessor of the National Marine Fisheries Service, at the age of 21 and who, in that capacity, made many distinguished contributions to American fisheries research over a period of several decades. His career centered on the Pacific Ocean and it was he who conducted pioneering studies of the fishes of the Hawaiian Islands. It was fitting, therefore, that when, in the 1950's, the Pacific Oceanic Fishery Investigations was established in Honolulu under the leadership of the late Oscar Elton Sette, the organization's first research vessel should be named after this notable figure in fisheries science. The 122-foot research vessel *Charles H. Gilbert* was commissioned in 1953. She was decommissioned in February 1973, and in August, sold at public sale. In the course of her two decades of service, she made 130 cruises, traveling more than 350,000 miles. Her history is written in the scores of published scientific papers that have brought new understanding of the fishes, fisheries, and oceanography of the central Pacific Ocean. One unusual feature of the *Charles H. Gilbert* was her underwater viewing ports, just below the water line. From these, scientists made visual and photographic observations of the behavior of skipjack tuna that have been widely reported. One of these photographs, showing a school of skipjack tuna feeding is, I would guess, probably the most frequently reprinted photograph of fishes ever taken. We print on this page one last picture of the *Charles H. Gilbert*, a vessel which truly honored the memory of the fine scientist whose name she bore.

• The Pacific Science Association held its Second Inter-Congress at the University of Guam in May. The Association is an international, regional, scientific organization founded in 1920. It sponsors Congresses every four years. Inter-Congresses are held midway between Congresses.

The Guam meeting passed a resolution I find of uncommon interest. It is reported in the Pacific Science Association Information Bulletin, Bernice P. Bishop Museum, Honolulu, Vol. 25, Nos. 3 and 4:

> Marine resources in the tropical Pacific are in need of conservation, including a scientific rationale for their sustained yield management. Indigenous Pacific island cultures include features that are in reality conservation practices in the guise of social customs, religion, taboos, and the like. Present scientific management research notwithstanding, application of such knowledge may become critical to the future ability of islands to carry and support their expanding population on a fixed resource base.
>
> Be it therefore RESOLVED that the Pacific Science Association support and promote a program of research in Marine Ethnobiology through its appropriate Scientific Committees or as a separate Association project.

• Still another in the series, "Marine flora and fauna of the northeastern United States," has been issued. This one deals with the pycnogonida. It was written by Lawrence R. McCloksey, Department of Biology, Walla Walla College, College Place, Washington. Walla Walla is a long way from the northeastern United States of course: The paper was written when McCloskey was a member of the staff of the Marine Biological Laboratory, Woods Hole, Mass. The 12-page illustrated publication is available from the Superintendent of Documents at a price of 30 cents.

• A new name appears on the masthead this month. It is that of Willis L. Hobart who assumes the position of Managing Editor of *MFR*. Hoby's qualifications for the job were briefly set forth in the Editor's Comments of the September number of *MFR*. An avid fisherman and a skilled photographer, it was he who contributed the uncredited cover photograph of a leaping salmon that we used on our October cover. It was he also who devised the ingenious layout of an article much praised as one of our most useful, Joe Pileggi's "Fuel Shortages and the Fisherman" in the September number.

Hobart

T.A.M.

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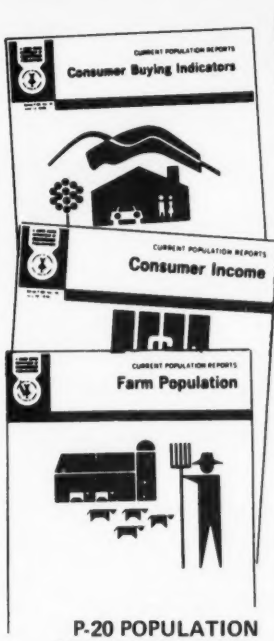

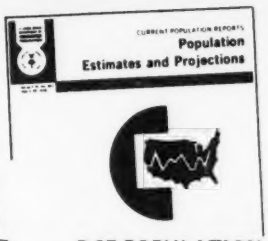

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